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ONE FORM OF ELECTRICAL ACTIVITY.

This has been a fairly busy week in electrical meetings in New York City. It is a good sign of intellectual activity in an art, and of corresponding mental alertness on the part of the individual engineers and practitioners. In fact, it might be argued that the well-being of an art is in pretty close relation to the prosperity and activity of its representative societies. Last Wednesday the New York Electrical Society devoted its monthly meeting to an important paper on electric traction. The same evening at the Chemist's Club the subject of a municipal electric light plant was considered. On Thursday evening the American Electrochemical Society visited the Elestrical Testing Laboratories and heard addresses there. On Friday evening the American Institute of Electrical Engineers took up the important subject of the National Bureau of Standards. Any man taking in all this would have kept himself well up to date, though he might not have had much time left for social duties and pleasures, or for other technical meetings, of which there were also some of interest electrically.

THE RATE OF RECOMBINATION OF IONS IN AIR.

We read so much about the production of ions in air and other gases, and we read so little about their disappearance after having been produced that we are apt to surmise that perhaps ions once produced never do disappear, but live happy ever after. When, for example, X-rays are caused to traverse air, we know that air particles or molecules in the normally neutral electric condition are split up into ions; that is, into electrified constituents, the sum of the positive charges being equal to the sum of the negative charges. It is, however, known that the ions, when left to their own devices, tend to recombine and disappear into neutral molecules, the original condition from which they started. It may well be imagined that a positively electrified particle, flying about in a gas, tends to attract any wandering negatively electrified particle that may chance to come within the sphere of influence. If the velocities of these two oppositely electrified particles be propitious to the procedure, the particles will approach until they unite in permanent and stable neutrality. It may readily happen that ions once brought into existence may tend to produce others, if an electric field be present. In the presence of an electric field of force, the electrified ions are impelled along the field, either upstream or downstream, according to the sign of their electrification, with a velocity depending upon the strength of the field and the time elapsing between collisions. In a powerful field and a low-pressure gas, the velocity acquired by the ions makes their collisions with innocent neutral particles very disturbing to the equilibrium of these neutrals, so that above this critical velocity the collision is followed by a rupture of the neutral into a positive and a negative ion.

Starting, say, with a single pair of ions, and a sufficiently powerful electric field, this pair can play such havoc with the peace of neighboring neutrals that in a brief interval of time an enormous number of ions may be brought into existence. It would seem, therefore, as though the ions in a gas were never quiet. They must either create new ions with frantic zeal, or they must unite with ions of opposite sign and disappear from active duty as independent electrified citizens. At any instant both actions may be going on simultaneously in a given region, new ions being born while old ions are disappearing. A steady state of ionizing activity is attained when the rate at which ions are produced is equal to the rate **at**

which ions are reduced. In a recent number of the *Physical Review* there is an article by Mr. L. L. Hendren on an experimental determination of the rate at which ions in air recombine. For the purpose of this research, a radium salt was employed as the ionizing agent. Under any given conditions of pressure and temperature in an ionized gas, the rate of recombination is found to vary as the square of the number of free ions per unit of volume; so that if the number of free ions be doubled, keeping all other conditions the same, the rate of recombination of ions will be increased four times. The results detailed in the article go to show that as the pressure of the gas is reduced, or the mean free path of an ion increased, the rate of recombination, for a given number of ions per cubic centimeter, is reduced, so that recombination is favored by pressure in the air at least as far as ordinary atmospheric pressures.

THE INEFFICIENCY OF GENERATING STATIONS.

Mr. Hobart's study of the net annual efficiency of electric supply stations is illuminating, though not precisely cheering, and ought to be given more than a passing glance by central station managers. The tables are a grim commentary on current steam practice. It is not a pleasant thing to realize that, reckoning from the coal pile, which is the most practical basis since it is fuel bills that one has to pay, the ordinary large station of the better class abroad shows at the switchboard only six or seven per cent efficiency. If one wishes to follow the trail still further he finds that in electric lighting not more than three or four-tenths of one per cent of the total energy is delivered as useful light energy at the lamps. The rest is frittered away as worse than useless heat at various points in the long chain of transmutations. Of course, so far as possible improvements go the opportunity is not so great as the figures indicate. Taking this world as it is, and the only one in which our readers are likely to be in the electric lighting business, its natural limitations as regards temperature range are such that some 70 per cent of the total thermal energy is now utilizable in steam energy. Of the energy within the temperature conditions the waste is not terribly great, so that the most hopeful line of economy is to extend the working temperature range, as is being done with superheated steam and with gas engines. Electric generators are as transformers of energy already too efficient to permit of any considerable improvement, so that the practical chance for improvement lies in the boilers and furnaces of the engines and in the load factor applied to each.

Only the most determined efforts at improvements all along the line can give even a moderately satisfactory result judging from the criterion set by Mr. Hobart in the energy recovered from the mechanical equivalent of the heat of combustion of the fuel. Let us put the question with brutal frankness: The calorific value of the fuel is, say, 9,000 kw-hours per ton. How many kw-hours per ton are *you* getting? And why? Are the general parts of your equipment as good as they ought to be, and are they kept at anywhere near their best performance? Why do "practical" men so often speak contemptuously of what they are pleased to call "test conditions"? Is there anything mysterious about them save that the apparatus is put in good condition and used, as it was intended to be, intelligently? We know from repeated tests with superheated steam that a first-class direct-connected set with compound condensing engines can pass up the kw-hour on about 15 pounds of steam at its most economical load even now, and we also know from repeated boiler tests that this steam should be delivered from the boiler for the consumption of not far from 1.5 pound of coal. Yet the station man generally smiles a gloomy smile and mumbles something about "theory" and "test" conditions and goes on paying for 3 to 5 pounds of coal per kw-hour, even at a good load. That kind of "theory" and those "test" conditions are what he needs to pay dividends with. Now we are perfectly well aware that very few electric stations are operated under good load conditions on account of varying demand, but if the station is properly planned and is reasonably large there is no reason why the machines in active, operation should not be working under much better load factors than is now usual, and consequently at higher efficiency.

Bad firing, too, is responsible for very serious waste in many central stations. In these days of automatic stokers the cheap and shiftless fireman should have no place; unfortunately, trade unions would decree otherwise. It is probable that a really good fireman can beat the performance of an automatic stoker, but the latter can give results month in and month out far better than can be reached by the set of firemen too often found as the logical consequence of false economy. If one stops to think of the value of the coal daily handled by a fireman, and then realizes that a third of that value can be gained or lost according to the fireman's skill, there is found ample food for reflection. And following out the matter of economy still further, what becomes of the steam that is generated? Is the performance of the engines in the average large station known or merely guessed at? In the gross it is all very well to look at the coal burned and the kw-hours generated, but the distribution of the losses is all important in checking them and guesswork does not go. Of course, it is well known that most electric stations use a painfully large amount of coal per kw-hour, and in a sense Mr. Hobart's paper is merely confirmatory. The thermal value of the coal in kw-hours per ton is, however, a particularly striking starting point in the reckoning which brings the shortcomings of even good modern plants very vividly before one. Looking over some of the convenient data from American plants, we have the consolation of noting that they are as good as the best of the plants cited by Mr. Hobart; indeed, we judge some of them to be a shade better than any in Mr. Hobart's list, but even in the best of them there is plenty of room for improvement. The next few years will see considerably higher economy than now rules. The stimulus of competition between turbines, engines with high superheat and gas engines is rapidly making itself felt, and the day is coming in which we shall see stations put in with a guarantee of efficiency reckoned from the coal pile. Efficiency counted from the steam condensed is very well so far as it goes, but it is far from telling the whole story of thermal losses, which must all ultimately be paid for.

INDUCTION MOTORS FOR TRACTION.

In connection with the application of alternating currents to electric traction, much thought has been expended on schemes for eliminating the commutator type of machines, it being held as obvious that the squirrel-cage or coil-wound rotor of an induction motor has an advantage over an armature with a commutator. In regard to the two major difficulties inherent in the polyphase motor when used for traction, namely, its constant-speed characteristic and the necessity for the use of three conducting wires, the advocates of the induction motor system claim that the power recuperated during retardation compensates for the excess lost during acceleration, and that the difficulties due to the use of duplicate trolley wires are of minor importance. It is evident that in investigating the importance of these difficulties, experience is of more value than theoretical arguments. The article on page 860 of our last issue tends to show that in practical service the three-phase induction motors have operated in a manner entirely satisfactory to those responsible for their installation. A most encouraging feature of the alternating-current railway situation is that those who have installed polyphase systems have failed to detect any unsurmountable difficulties, and are loud

in the praises of its advantages, while those who have employed single-phase commutator motors have been equally pleased with their operation.

In examining the characteristics of the induction motor one is forcibly impressed with the fact that, although means may be employed for causing the machine to exert its maximum torque at any speed from standstill to a few per cent below synchronism, in no case can the efficiency be as great as the speed in per cent of synchronism. The seeming increase in efficiency at fractional speeds with concatenated connection of the motors is due solely to the change in the synchronous speed, and the relation expressed above is not altered thereby. When one compares the limited speed range of the induction motors with the economical speed range of the motors possessing series characteristics, he is apt to conclude that the former machines are very much less efficient at low speeds than the latter machines. It is not proper, however, to neglect the fact at the moment of starting each type of motor has an efficiency of zero, and that under starting conditions the induction machine, on account of the lack of a commutator, is essentially at a great advantage. Experience shows that the mere fact of the induction motor possessing the characteristics of a shunt machine is not sufficient to preclude its adoption for railway work. In connection with the difficulty incident to the use of induction motors for traction, it is interesting to investigate the possibility of employing a single trolley wire by making use of the self-starting single-phase type of machine. As is well known, the magnetic field of a single-phase induction motor when the rotor is at full speed is of constant value and rotates uniformly, while at zero speed the magnetism is unidirectional in space and alternating in value. Since the torque produced by a certain secondary current depends upon the product of this current with the magnetism in space-quadrature and time-phase with it, it follows that the torque exerted by a simple single-phase motor at a certain speed is equal to the product of the rotor speed and the torque exerted by the corresponding polyphase motor, and hence is zero at standstill. In order that the motor may possess a torque at zero speed, it is necessary that it be supplied with magnetism in space-quadrature and time-phase with the secondary current, which result can conveniently be obtained by the use of suitably selected impedances properly disposed.

The Digest for this issue contains an account of an investigation by J. Dalemont on the use of condensers with single-phase motors during both the starting period and normal operation. If a motor with a three-phase delta-connected primary winding be supplied with normal electromotive force across two leads and the potential of the third lead be displaced relatively from a potential line joining the other two leads, the machine will exert a starting torque proportional to the product of the percentage displacement and the starting torque exerted by the normal three-phase machine. Thus, if the quadrature potential displacement is equal to $\sqrt{3/4}$ of the e.m.f. impressed between the two leads, the starting torque will be the same as that of the polyphase machine, and it may be made equal to the maximum torque of the equivalent three-phase motor by employing the proper secondary resistance. A displacement having the value indicated above may be obtained by the use of condensive impedance in series with inductive impedance, as indicated in the Digest. Under these conditions the motor operates as a three-phase machine, but possesses the added advantage over the usual three-phase motor of requiring a smaller current input, since the quadrature magnetism is supplied by the condenser current, and the power factor is correspondingly increased. The author shows that the performance of the motor may be considerably improved by relatively reversing the terminals of the main phase winding from the usual connection, in which event the magnetism due to the currents in the three separate phase windings operate to give torque in the same direction. It is seriously to be regretted that satisfactory condensers suitable for such work on a large scale have not as yet been produced. That a large demand would immediately follow the introduction of commercial condensers of large volt-ampere capacity occupying small space and light in weight, is beyond any doubt.

MAGNETIC IRREVERSIBILITY OF CERTAIN ALLOYS.

A note on the subject of the magnetic irreversibility of Heusler alloys by Mr. B. V. Hill appears in the *Physical Review* for November. Certain compound steels are called irreversible, from a magnetic standpoint, because when heated to a certain critical temperature they become non-magnetic; but on reversing the process by cooling they do not regain their magnetic quality at the same critical temperature, but remain non-magnetic until a much lower temperature is reached. On the contrary, soft iron has a critical temperature at about 700° C. When heated above that point it becomes non-magnetic; but on cooling it regains its magnetic property at the same temperature. This means that iron is magnetically reversible. Selecting a bar of copper-manganese-aluminum alloy, the material was found to be magnetic at room temperatures. When it was heated to about 370° C. it gradually became non-magnetic. On cooling it reacquired nearly all its original magnetic properties. When, however, it was heated to 500° C., it remained almost non-magnetic after cooling. In other words, it was magnetically irreversible at the temperature of 500° C. When the same rod of alloy was heated to a temperature of about 850° C., it regained its magnetic property, and the property persisted during and after cooling. If this result is capable of being reduplicated, a curious relation presents itself. We have first an alloy that is magnetic at ordinary temperatures. Then it loses its magnetic properties when carried up to 500° C. in such a manner that they are lost and forgotten when the substance is cooled. But if the substance is carried to a bright red heat, not only is the lost magnetic power regained at this temperature, but it is retained on cooling.

Our present knowledge of magnetism gives no clue to the causes of the curious magnetic behavior above described. The only comfort is that the physical behavior of alloys is a maze of apparent inconsistencies that awaits the work of future researches to unravel. The mere fact that three non-magnetic substances like copper, manganese and aluminum when melted and cast together form a strongly magnetic alloy, makes sufficient mystery for the contentment of any single energetic investigator. It is suggested as a speculation, in the article referred to, that possibly manganese might be found to possess magnetic properties at a sufficiently high temperature. Much work will have to be done in the investigation of magnetic behavior of alloys before we can predict whether metals can be produced with a greater magnetic power than iron and steel. It is conceivable that an alloy might be produced which would have a greater permeability and carry a greater flux density than steel, so that a smaller cross-section and weight of the metal might serve for use in a dynamo. If such an alloy were discovered and it was fairly inexpensive to produce, it might come into extensive use in dynamo construction. But at the present time this is pure speculation, because no alloy has yet been discovered which approaches in magnetic properties to soft iron and steel. All that we can say with certainty is that the storehouses of nature are vast beyond our ken, and that at any time persistent endeavor may bring facts to light sufficient to upset our practical applications and commercial processes.

The Indiana Municipal League.

Municipal franchises and municipal ownership of public utilities were the principal subjects discussed at the 14th annual meeting of the Municipal League of Indiana November 15. The discussion was opened by an address on "Municipal Franchises" by Finley P. Mount, City Attorney of Crawfordsville. Mr. Mount said his experience was that the success or non-success of municipal ownership of public utilities was largely a matter of bookkeeping. He said it was an easy matter to render reports or trial balances—one in favor of and one against municipal ownership. He said it was absolutely impossible to divorce their management from politics. "Every employee in a plant under municipal ownership," said Mr. Mount, "from a coal shoveler up, knows he owns his job through political preference. You cannot get municipal ownership separated from politics, no matter how hard you may try."

Mr. Mount gave a history of the trials and tribulations encountered by the electric light plant at Crawfordsville, owned by the city, saying that for 15 years it was operated at a loss, and while it is now being operated by a bi-partisan board in a paying and satisfactory manner, the experience had been a very expensive one to the city. He told of a long list of delinquents and of persons who were benefited by free service, many of whom were city officials who indignantly denied any intimation of graft. He then spoke of the water works in Crawfordsville operated by a private corporation. He said the city was enjoying excellent service and he attributed it to the strength of the contract with the water company. No reliance, he said, could be placed in a forfeiture clause in a franchise, especially in a water franchise. The strength of a water franchise lies in the financial penalties that may be assessed and withheld from the next quarterly payment. Penalties of this sort for failure to provide water of a specific degree of purity, and failure to keep the pressure up to a certain point and other penalizing safeguards should be in every franchise contract, he said. He closed his address by saying that for a period of twenty years or more he was confident a city would get better results from properly framed and well guarded franchises to private corporations, for public utilities than from municipal ownership and control.

Mr. Mount's address and points aroused quite a discussion, Mayor Becker, of Hammond, leading in an argument in favor of municipal ownership of public utilities excepting when the indebtedness of a city precluded in favor of a grant of franchise to a private corporation in order to get service. He described how the municipal water works plant of Hammond was saving the city $30,000 a year —practically paying for itself. He condemned the methods of the private corporations in issuing bonds on the earning capacity of a plant rather than its actual cost, thereby compelling the public to pay interest on bonds sold for 25 cents on the dollar. He said private corporations have been known to control city elections and in such case they are a menace to a municipality. He said "if we cannot govern a municipal plant, it is evident that we are not able to govern ourselves."

Mayor France, of Huntington, said that he favored municipal ownership; that private corporations were gaining a stronger and more arrogant hold on the government, and that it is time to crush this arrogant power. He insisted that party politics should not enter municipal affairs; that the day will come when it will have no place in municipal affairs and municipal elections.

Mr. William Fortune said that he favored municipal ownership of water plants, and that there is no more reason why a municipal government should be a failure in the management of public utilities than in the management of other affairs. He said the better plan would be to allow the people to vote on an important franchise before it was granted to a private corporation.

A paper was next read "On Municipal Ownership of Water and Light Plants," by H. C. Ayers, mayor of Portland. Mr. Ayers' paper covered much the same ground and reasoning assumed by Mr. Mount. The delegates participating in the discussion were about equally divided in favor of municipal and of private ownership and control of public utilities.

The following officers were elected for the ensuing year: President, Fred J. France, mayor of Huntington; vice-presidents, B. R. Russell, ex-mayor of Crawfordsville and George R. Carr, mayor of Greenfield; secretary, John F. Taggart, Clerk of Richmond. The next meeting will be held in Marion, June 15, 1906.

Latest Municipal Lighting Statistics from Detroit.

The tenth annual report of the Public Lighting Commission of the City of Detroit, covering the year July 1, 1904, to June 30, 1905, has just reached us in its pamphlet form. In July the commission gave some advance figures to the local newspapers and we reprinted some comments thereon by *The Michigan Investor*. (See ELECTRICAL WORLD AND ENGINEER, August 12, 1905.) The issue of the report in its final form calls for some comment at our hands. The tenth report gives as usual a careful analysis of the expenditures made on operating account by the Public Lighting Commission. The completeness of this statement has always been very creditable to the Detroit Commission, and it is also to the credit of the commission that every report has shown economical operation.

On page 22 there is a statement of charges made to Investment Accounts, also in good form. On page 23 there is the usual statement of Depreciation Account, entries for the year covered by this report being as follows:

By amount added to cost of lights for discarded lines, machinery and lamps, year ending June 30, 1905	$15,827.19
By amount added to cost of lights for depreciation for year ending June 30, 1905	26,991.53

We have in the past pointed out that the depreciation account of the commission was utterly inadequate, and we have no occasion to take back what we have said; but it is fair to compliment the commission on the first of these two entries. It shows an awakened commercial conscience and gives hope that sooner or later these annual reports will recognize depreciation in an adequate way.

The commission still avoids—we may say evades—the true method of arriving at the value of its property. On page 10 of the report the statement is made that the present value after making deductions for all possible depreciations is $872,726. Reference to page 23 shows that this figure is the resultant of the sum of all the charges to investment, less the chronic 3 per cent per annum depreciation charge, which we have so often challenged; and less, in addition thereto, the charge of $15,827.19 on which we have just congratulated the commission, and two small charges of a similar character in previous years. The statement on page 10 is, therefore, merely a book value and not an inventory value. During the past year the commission was given an opportunity to have its property inventoried at the expense of private parties. A local electric light company deposited with the Common Council $1,000 to be used to pay the cost of an inventory of the Public Lighting property by the dean of the engineering faculty of the University of Michigan, or by engineers acting under his direction, the lighting company offering to add to the $1,000 whatever further amount might be necessary to pay for the inventory. The commission when invited by the Common Council to accept this offer refused to do so, presenting as its final excuse after much verbiage, the statement that it did not think the public interest would be served at this time by the making of such an inventory. We cannot conceive what interest, public or otherwise, can be served by the concealment of the value of a public property. If it were the act of office holders concealing graft or malfeasance, comprehension would be easy; but that men notably above suspicion should have reason for concealing the condition of a public property in their care is a thing passing all understanding.

In the introductory pages of the report the commission takes a new ground in its annual argument as to the value of the plant to the City of Detroit. Incidentally, we think that the commission has been in the habit of overdoing its argument. *"Qui s'excuse s'accuse."* The new exhibit is on pages 8 and 9. It shows the total appropriations by the Board of Estimates for the construction and operation of the Public Lighting plant from the beginning until June 30, 1905, $2,172,451.80. It divides this sum by the number of arc lights operated one year during the ten-year period and arrives at the conclusion that were all the property under the control of the Public Lighting Commission obliterated, including the land on which the plant stands, the total cost to the City of Detroit from June 30, 1895, to June 30, 1905, would have been $87.63 per arc light per year. Having arrived at this conclusion the commission proceeds to compare this total cost with the prices paid in other cities and the prices paid more than ten years ago for the lighting of Detroit streets by contract.

It is characteristic of the commission's position that it does not take

the opportunity to make comparison with the cost of arc lights furnished by private companies during the ten-year period in the City of Detroit or in villages adjacent to the city. It does make comparison with a bid made for a Detroit ten-year contract more than twelve years ago, but omits to recall that the City of Detroit could not lawfully have accepted that bid, even had a corrupt council been willing to do so; and also omits to say that at any of the legal three-year contract periods since the beginning of the 12 years the city could have obtained contract lighting on much lower terms.

It is even more characteristic of the Detroit Public Lighting Commission's peculiar point of view that it forgets to include in its statement of total cost of the plant an item of $281,000 interest. It has been explained to the critic many times that the Public Lighting Commission does not pay this interest, but that the city treasurer does. That does not alter the fact that the interest is part of the total cost of the plant, and it does not warrant the Public Lighting Commission, over the signature of its president, in stating that the total cost of the plant was a certain amount when the true total cost has been $281,000 greater. We do not believe that any one of the gentlemen of the Public Lighting Commission of the City of Detroit would wilfully omit interest from a statement of his own business prepared for a commercial agency or for a bank, or from the annual report of a corporation of which he was a director. For that matter, we do not believe that any of the commissioners would operate his individual business for ten years without making inventory of his machinery and stock. We cannot comprehend why business men should cease to be business men when they become Public Lighting Commissioners, and we ask our readers to remember in contemplating this mystery that these Detroit gentlemen are not practical politicians, nor "grafters," but are unpaid commissioners working only for the credit and good of their city. How the credit and good of their city can be served by their forgetting essential truths in the preparation of their annual report is a mystery.

If we add the forgotten $281,000 to the commission's exhibit of cost it adds to their resultant figure of $87.63 per arc light per year, another $11.34, making the correct figure $98.97. If this be done the commission's exhibit must be accepted; but after all it is only a *tour de force* and the result is of no value to those of us who have occasion to study real costs. To make it of value it will be necessary to prepare that evaded inventory of the property and to deduct from the foregoing $98.97, a figure which would be the quotient of the inventory value using the total arc-lamp-years as a divisor. Seeing that guesses at the value of the Public Lighting property of Detroit are in order—for the book valuation by the commission is neither more nor less than a guess—we submit our guess as $581,817, and the resultant of this is an annual cost, calculated by the new method evolved by the Public Lighting Commission, of $65.50. To this we must now add the item of taxes lost by the city in that its municipally-owned plant is not taxable, while a similar plant owned by private parties would be taxed. It is to the credit of the commission that it makes some allowance for this in all its regular statements. It is our remembrance that in an earlier report the commission stated that its property had been assessed at its request by the tax assessors, but in later years the commission seems to have guessed at its own assessment. According to the commission's reckoning the item of lost taxes would be about $2.50 per lamp per year. It rather startles us to note that while the commission flatly states the present value of its property as $872,726 it estimates its assessible value as $500,000. After ourselves guessing the value we are not fairly permitted to challenge the commission's alternative guess. We feel rather disposed to think that in assessing the property at $500,000 the commission meant the public to conclude that the value lay somewhere between that and the preceding inflated statement. And the final of all this figuring is that arc lights for ten years past have cost Detroit $68 per year.

Besides this extraordinary exhibit the commission presents its customary calculation of cost. This calculation includes interest, lost taxes and the 3 per cent allowance for depreciation. This year it works out as $59.34 per lamp. We are not willing to accept the commission's depreciation estimate, but the additional allowance for discarded machinery during the present year entitles the commission's figures to more than customary credence. We trust that we shall be able, as a result of the commission's complete recognition of depreciation of its property, to give to the corresponding figure of the eleventh or twelfth annual report the entire credence to which the personal standing of the commission would then entitle it.

An amusing paragraph on page 11 deserves notice. It is the answer of the commission to *"unjust and uncalled-for attacks on the Public Lighting plant by private lighting interests here and elsewhere."* The commission says that the persons who were responsible for these attacks had been led to believe that the commissioners favored going into the business of private lighting, whereas the contrary is the fact. We do not at the moment remember personally any unjust or uncalled-for attacks on the commission during the past year, although we have seen criticisms which erred as far on one side of the line of exactitude as the commission's reports usually err on the other. The reports have usually provoked the criticism and it is eminently proper that in this case the criticism should provoke the report. But the commission does not come before the public with clean hands. It in this report repudiates any desire on the part of its members to go into the business of private lighting, but there are earlier reports in existence perchance prepared by earlier commissioners. In the seventh annual report, page 10, we have two paragraphs setting forth the great success elsewhere of municipal enterprises and ending as follows: "Were we allowed to do this work (i. e., private lighting) and charge the going price per kilowatt we could light the city for nothing and have a handsome balance in our treasury at the end of the year. If the citizens of Detroit were fully aware of the delights and comforts they have within their grasp from their Public Lighting plant I think they would insist that it be allowed to serve them."

The commission can hardly repudiate its seventh annual report unless it proposes to repudiate as individuals the former member or members who prepared that report. If we recall the tenor of the Detroit newspaper articles furnished by our press clipping bureau the commissioners were quoted within the past year as strong proponents of the performance of private lighting by the public plant. We conclude that this plea of "Not Guilty" is entered on behalf of the six members now forming the commission and represents a change of heart on the part of those who were included in the membership during the seventh year. On this we felicitate these gentlemen; and we congratulate the commission as a whole on its official recantation of its former error.

The foregoing criticism has been prepared with reference to the documents in the case, and without a simultaneous inspection of the property. From several sources there come to us tales to the effect that the lighting service given by the commission is worse now than ever before, and that the plant, particularly the pole line, has been positively neglected. From press clippings we gather that blame has been laid on the plant for a recent fatal accident because of the alleged dangerous condition of the overhead wires. These are matters which require before they are made the basis of any adverse comment, a more careful inspection and report than is at present time available for our use.

Meeting of the New York Magnetic Club.

The New York Magnetic Club held its fall dinner at the Hoffman House, New York, on the evening of November 15, over 200 members and guests being present. The handsome banquet hall was tastefully decorated with American flags, and this, together with the effective electric illumination of the room, presented an attractive scene.

Delegates to the meeting of the Telegraphers' Mutual Benefit Association, which was held in the afternoon, were guests of the club, and altogether a very enjoyable evening was spent. Col. A. B. Chandler, president of the club, presided, and at the table with him were several prominent officials of both the telegraph companies. Among others present were Prof. Samuel Sheldon, T. D. Lockwood, Stephen D. Field, Ralph W. Pope, Henry W. Pope, H. L. Shippy, F. W. Jones, A. G. Mills, Dr. A. S. McAllister and many others well known in the different branches of electrical activity.

An excellent dinner was served, this being accompanied by instrumental and vocal music. A quartette of Mexican troubadours, dressed in native costume, was a feature of the entertainment. After the dinner, speeches were interspersed with the musical and other parts. The presence of the "sacred three," which title has been applied to A. B. Chandler, D. H. Bates and C. A. Tinker, the three cipher telegraphers during the Civil War, was noted and commented on.

Graphitizing Filament Patents Expired.

By Edward P. Thompson.

TO show that manufacturers of incandescent electric lamps are free to make graphitized or so-called metallized filaments without danger of infringing any patent, comparative quotations are submitted below and taken respectively from Mr. John W. Howell's Institute paper of last June, and from expired patents granted to me in 1887, Nos. 370,992 and 370,995, sold to the Westinghouse Electric & Manufacturing Company, in 1889.

From the Institute paper: "To produce the effects described in this paper, the heat is externally applied to treated filaments at atmospheric pressures." From one of my patents: "To raise them," the filaments, "to a sufficient temperature to cause them to break." Again, "Surround it," the filament, "with an atmosphere of hydrocarbon" at or below or above atmospheric pressures, "then subjecting it to heat by passing a current through it, and while thus heated, causing it to break at a predetermined point," thereby insuring a long filament to break at such a point by the high temperature, as to leave the filament still long enough for the lamp. The patents show also the heating to only approximately the point of rupture. To allow a long enough time for the permanent set or transformation to take place, which is doubtless a kind of cooking or chemical process, the approximate breaking temperature may be maintained a few minutes in an inert atmosphere or vacuum, instead of in hydrocarbon vapor. One of my patents reads: "Heating a filament to approximately its point of rupture during the latter part of the process of evacuation." This approximation was arrived at by noting on the ammeter the breaking current of several filaments successively, and then limiting the permanent set current to a little less than this maximum. Occasionally it was necessary to discard a filament which broke at this limit. In the Institute paper there is, therefore, no novelty in not letting the filament break; besides, in the electric furnace the heat of 3,700° would evacuate the porous space in the carbon powder around the filaments. The air is highly rarefied in such a furnace, or else the filaments would burn up instantly. By my process of heating by electric current, the inert atmosphere around the filament may be under high pressure if preferred, which is not possible in an electric resistance furnace.

From the Institute paper: "The temperature was usually between 3,000 and 3,700° C." From one of my patents: "And purposely causing them to break by reason of such temperature." The paper mentions no such intense heating as to cause the filament to melt into two parts. No higher temperature can be imagined than that which will actually rupture the filament in the absence of oxygen.

So much for the invention itself. Now for the effects:

From the paper: "Its changed nature is also indicated by its toughness and flexibility." From one of my patents: "The carbon thus treated is also found capable of being bent and strained with less liability to break."

From the paper: "Metallized filaments blacken the bulb very much less than ordinary filaments." From one of my patents: "It also throws off less carbon and thus prevents the interior of the globes from becoming so quickly blackened."

From the paper: "Metallized filaments, as thus described, are much more stable at high temperatures than ordinary carbon filaments." From one of my patents: "Having once been broken in this manner —subsequently, the filament will not be broken except by an application of an equal amount of heat," other things, of course, remaining the same. Also, "a filament which has thus been raised to a high heat, is capable of greater endurance than those which have been treated at a moderate temperature."

From the paper: "Its graphite coating looks as though it had been melted." From one of my patents: "The extreme temperature . . . . causes the carbon to pass through a viscous state." It was this feature that led me to the discovery. In experimenting on filaments at a high temperature, higher than what had been suggested at that early date, eighteen years and more ago, I found that a carbon filament would bend of its own weight, by becoming, of course, viscous. I then decided that to expose filaments purposely to high temperatures, would have the same effect upon them as to heat scraps of metal until all the small pieces fused into a solid mass.

From the paper: "Its specific gravity is also much higher than it was before heating." From one of my patents: "And when it cools, it is more dense."

From the paper: "They have been given the name 'metallized filaments.'" From one of my patents: "Producing a permanent set of the molecules in a filament," like steel, which as well known, may be given a permanent set.

From the paper: "The conclusion that the effect is produced by material being driven out." From one of my patents: "The extreme temperature to which the filament is subjected drives off every particle of gas from the carbon."

From the paper: "Curve No. 5, 200 per cent of normal pressure, or at 280 candles, for a 16-cp lamp. Curve No. 6, is the curve of a filament heated hotter than No. 5. The temperature was not measured by this method *for fear of breaking the lamp.*" From one of my patents: Purposely causing them to break by reason of such temperature. "Therefore the temperature in my experiments and in the treatment of actual carbons, was of course, very much higher, as a new treated carbon filament will not break as soon as an older filament."

From the paper: "This high temperature treatment of the base," meaning the bare carbon, "is, however, a beneficial step in the process here described." My patents show intense heating of either a bare carbon, a treated carbon, and also heating to softness a treated carbon in hydrocarbon, and then the same filament again, while exhausting, the break being so managed as not to spoil the filament."

The only difference consists in different kinds of electric furnaces being used. To change the source of heat is probably not patentable, and has not been patented to the time of writing. Dr. W. R. Whitney deserves credit for being the first on record to measure the increased efficiency of filaments exposed to extreme temperatures.

United States vs. German Patent Office Practice.

In the communication printed in these columns last week entitled "American Inventors in the German Patent Office," President Hauss referred to a report by Consul-General Frank H. Mason on United States vs. German Patent Office Practice, and urgently recommended the reading of this report by those who believe they have reason for complaint concerning the treatment of their German patent applications. The report of Consul-General Mason thus referred to is reported below:

It is a matter of common knowledge among inventors and others who are interested in patent law practice that, while the United States and Germany are by common consent the two countries in which inventions are most intelligently and thoroughly examined and in which, therefore, a patent once obtained is most valuable, there are certain radical differences in the methods of the patent offices at Washington and Berlin which, being often misunderstood, lead to disappointments, recriminations, and litigation whch more exact knowledge mght have averted.

It is not uncommon to hear American and other foreign inventors complain of a hostile and forbidding attitude on the part of the examiners at the German patent office, as though the duty of the latter were to assume that every invention presented for a patent is defective or plagiarized until the contrary is proven—in other words, to discourage rather than encourage the protection of meritorious inventions by patent. It requires but slight experience in such matters to show that in many, if not a majority, of the cases the troubles of American inventors at the German patent office are due to their failure to realize the difference in the two systems of application, by reason of which an application which would be correct at Washingtou would inevitably fail at Berlin for informalities which any clerk in a patent lawyer's office should recognize and be able to correct. It is beyond the scope of a consular report to enter exhaustively into this subject, but a few of the more obvious differences may be cited as illustrative examples.

In the first place, a foreign inventor may not deal directly with the imperial German patent office. He must be represented here by a patent attorney of recognized standing, by whom the application and specifications are presented, and through whom additional details or explanations may be asked for by the examiners. This does not mean, however, that the foreign inventor need necessarily send his application through a long international chain of offices, which may not infrequently involve needless delay and expenses. There is kept at the German patent office a list of recognized patent attorneys who are located in Berlin and throughout the Empire.

Secondly, specifications and claims for patents on American inventions are frequently presented in the form of translations made by persons who have only an acquired and superficial knowledge of German. Such translations, made with the aid of a dictionary, mechanically translate the words, and not the meaning, of important phrases, so that the specifications and clauses as filed are often incomprehensible. This entails additional correspondence, corrections, and frequently long delays which might have been obviated. Few persons, comparatively, are capable of translating a technical description so that it shall mean exactly the same in a foreign language as in the original, and it is this want of exact completeness that often loses a foreign patent or renders it, if gained, loose in its provisions and impaired in value.

Many inventors and even some attorneys in the United States seem not to understand that section 2 of the German patent law prescribes that an application for a patent in this country must be filed (1) before the invention has been disclosed in any generally accessible publication during the past hundred years and (2) before it has been so publicly used or exhibited in Germany that anybody skilled in the art to which it relates could carry out and utilize the invention.

This differs radically from the provision of section 4886 of the United States statute, as revised February 9, 1897, which allows the first inventor to obtain a patent on his invention even after it has been made known (except by previous patent, in which case the application must be filed within seven months after the date of the application for said previous patent), provided he files his application within two years from the time when the invention was first publicly disclosed. A want of exact knowledge concerning this variation between the practice of the two countries leads to the presentation of American claims in Germany which can not be granted, because the antecedent record of the invention in respect to publicity is in violation of the German law.

But the chief difficulty, upon which more hopes are wrecked than any other, is the radically different views taken by the American and German authorities as to what constitutes a single patentable invention. This difficulty is more especially obvious and serious in the case of a machine composed of a number of parts, on each of which priority of invention is claimed. Patents are granted in the United States for new constructions and combinations which in Germany would be required by section 20 of the imperial patent law to be divided and covered by several different patents. Consequently, applications are often received here which, being substantially translations of specifications prepared for use at Washington, have to be rewritten and divided into two or more individual applications before any examination can take place. This, of course, entails delay, expense, and introduces a new element of uncertainty into the case, since one or more of such separate claims, which are all covered by one American patent, may be rejected by the German examiners.

As an example of this fundamental variation in practice may be cited the sample specifications and claims on improvements in a meat-chopping machine which is given in the rules of practice published by the United States Patent Office. The preamble states as follows the three objects to be obtained by the invention, viz:

(1) To provide a continuously lubricated bearing for the chopping block;

(2) To afford facilities for the proper adjustment of the knives independently of each other in respect to the face of the block; and

(3) To reduce the friction of the reciprocating rod, which carries the knives.

Then follow the four claims setting forth the separate elements of the machine by which these three problems are solved, and protection is afforded for the elements in the combinations by which the desired results are reached. To facilitate the reference, the exact wording of the clause is herewith given:

(1) The combination, in a meat-chopping machine, of a rotary chopping block having an annular rib, with a table having an annular recess and a pocket communicating with the said recess, all substantially as set forth.

(2) In a meat-chopping machine, the combination of a rotary chopping block with a reciprocating crosshead carrying knives, each of which is vertically adjustable on the said crosshead independently of the other, substantially as described.

(3) The knife *d*, having two screw rods, *m m*, attached to its back, substantially as shown, for the purpose specified.

(4) The combination, in a meat-chopping machine, of the reciprocating rod, carrying the knives, the crosshead secured to the said rod, and having anti-friction rollers, with guides, adapted to the said rollers, all substantially as set forth.

Now, a German patent claim is what is known in American practice as "functional." It provides protection for the means employed in the solution of a problem, and characterizes the different elements by which the solution is obtained by their functions, instead of by their arrangement and combination. For instance, claim 1 of the foregoing series would need to be rewritten for the German examiners into a form substantially as follows, which would of course be expressed in clear, idiomatic German:

A meat-chopping machine, in which vertically reciprocating knives operate in conjunction with a rotating chopping block, characterized by the fact that a rib provided on the under side of the rotating chopping block moves in an annular groove provided in a table and connected with a depression or recess filled with oil, for the purpose of sufficiently lubricating the block.

If such a claim were accepted in Germany as the first or principal claim, all the other claims in the same application would have to fall within its scope—that is, assist in obtaining the same end as is obtained by the first claim. But it is inadmissible in Germany to introduce the solution of a new problem in the second or following claims, so that in the instance above recited from the rules of practice, the second claim, which covers the combination of elements for obtaining the second object stated in the preamble, could not be included in the same German application as the claim 1, above quoted, because it relates to a different problem, or, in other words, is based on another and independent inventive idea.

It is impracticable within present limits to follow the comparison through in all its details, but it will be sufficient to say that these claims and specifications, covering three independent improvements on a known machine, and which can legally be covered by a single patent in the United States, would require three separate patents in Germany.

Each claim in the United States must be complete in itself, which not only means that no reference may be made from one claim to another, but also that each claim must cover a combination quite separate from and independent of the other claims.

Quite the opposite is the case in Germany. Here, the first claim is a statement of the invention, and all other claims must fall within the same scope. In this country, any number of "modifications" may be introduced in the subsidiary claims, while in the United States "alternative constructions" are inadmissible, and subject-matters introduced as "modifications," in subsidiary claims in Germany can only be properly claimed in the United States as new combinations, quite separate from and independent of the other claims.

Still another source of error is the lettering of drawings which accompany applications for German patents on inventions which have already been patented in the United States. In most cases the preamble, specifications, and claims are translations of the English text, in which a lever, for instance, is designated by *L*, a crank by *C*, a pinion by *P*, and so on. As the German rule requires that the first reference letter alluded to in the text must be *A*, the second *B*, and so on throughout, it is plain that the English initial letters, when fitted into a German translation in which lever is rendered by "Hebel," a crank by "Kurbel," etc., would not only be misleading, but meaningless.

An American inventor, who has had long experience in securing foreign patents for his inventions, gives it as his opinion that—

Two-thirds of the first rejections of American applications for German patents and the failures of American inventors to secure prompt attention and early issue are justified by the loose, informal manner in which they are presented, and this often by international patent attorneys of large experience and high ability, but who are prevented by the great volume of their business from giving personal and expert attention to details which they know, or ought to know, to be prescribed by law and therefore of the first importance.

The subject is one of immediate and steadily growing interest. No foreign people apply for and obtain so many patents in the United States as Germans, and in no country is it more necessary and to the advantage of American inventors to protect their inventions by patents than in Germany. A clearer and more exact understanding of the many differences in practice and theory between the two countries, of which the foregoing are typical examples, would save not only time and money, but avert friction and litigation which might well be avoided.

Investigation of Municipal Ownership.

A call has been issued by Mr. Melville E. Ingalls, chairman of the committee of twenty-one appointed to investigate municipal ownership under the auspices of the Civic Federation, for a meeting of the committee in this city on November 27. This committee was appointed by the Public Ownership Commission organized to investigate actual conditions of municipal ownership in this country and Europe. Mr. Ingalls is chairman of the board of directors of the Big Four Railroad of Cincinnati, and the members of the committee are heads of corporations, prominent college professors, journalists, publicists, and heads of unions in trades.

A sub-committee which has for some time been engaged in preparing a report on the scope and methods of the investigation has issued the following statement: "The report provides that a considerable number of plants of varying sizes, locations, and character be first visited in the United States and a careful investigation made by expert accountants and engineers into every detail of management. Not only will the public reports be considered, but the actual working of the plant in all its phases investigated by competent and impartial men. By these means the committee will be able to acquire accurate data regarding representative plants throughout the United States and the actual results of the various forms of management obtained both for public and private operation.

"This investigation having been completed and the detail work having been put well under way, the committee will visit Europe, proceeding first to England, and later to the Continent. Expert accountants and engineers will accompany the committee or be employed by it abroad, and the same careful, thorough, and comprehensive examination made into every phase of the subject. Special topics probably will be referred to sub-committees or single members of the commission, such as the French system of granting franchises, the leasing of municipally owned works to private management, as in vogue particularly in Italy and Germany; the English method of taxing both public and private plants, the Scottish methods of limiting charges of service to actual cost, the sale of public franchises at auction, popular control of grants through the initiative and referendum, methods of settling labor questions, etc.

"The purpose of the investigation will be to determine and record the facts; opinions are to be eliminated. Every essential point will be treated and ample time allowed for the collection of data, to the satisfaction of the committee. The report of the Committee on Plan and Scope, which outlines in detail the subjects to be considered and the questions to be answered, contains about 12,000 words.

"The important points and those likely to produce the most discussion are the effects of private and municipal ownership upon municipal politics, the appointment and removal of employees, the election of city officials, municipal corruption, wages, hours and conditions of labor, strikes, collective bargaining, organization of labor, character of service rendered, cost of service, method of assessing charges, economy of management, rapidity with which improvement in service and methods has been made, the financial results, and the effect upon the debt and taxation of the city.

"The history of the municipal ownership movement will also be written, and special attention paid to the methods of granting franchises to private corporations, the practical results of the various experiments that have been tried, and the methods by which private corporations and municipalities are controlled and supervised by Governmental authorities."

Building Up Central Station Business at Kansas City.

A recent interview of a representative of the ELECTRICAL WORLD AND ENGINEER with Mr. R. E. Richardson, manager of the Kansas City Electric Light Company, brought out some interesting and valuable points in connection with the very rapid growth of the central station business in that city since Mr. Richardson took charge of that company in 1900. This growth has been partly on account of the rapid growth of the city itself and partly because of the active efforts of the present management to give first class service, make attractive rates on a basis profitable to the company, and to push the business. Mr. Richardson sums up the whole situation in the statement: "People had always looked upon electric light as a luxury; we have brought them to consider it a necessity."

Kansas City, Missouri, with its neighbor, Kansas City, Kansas, form a community the population of which is probably now close to 300,000. The company now has seven solicitors in Kansas City, Mo., and four in Kansas City, Kansas, the latter town growing rapidly and having much manufacturing in it. Mr. Richardson lays particular stress on his policy of seeing that the customers on the electric lighting service are getting good returns for the money expended. To this ends he gives much attention to the question of illumination. He tells customers that what he wants is to give them something from which they will get returns, for he knows that any man is better satisfied to spend $100 on electric light and get his money's worth, than spend $5 and get no returns. "Kickers" who complain of the size of bills and insufficient light have their installations promptly investigated by a representative of the company, who shows them why the results are poor and what can be done to make the service more satisfactory. The company does not advertise in the daily papers. Mr. Richardson does not consider the city large enough to make this kind of advertising as effective as personal solicitation, and if advertisements are carried in one daily paper, they must be carried in all to avoid hard feeling, which involves a heavy expense

In connection with the question of illumination, Mr. Richardson has attempted to look after customers' interests by seeing that when window lighting is attempted, it is done properly. He points out to customers that the old plan of running a string of border lights around a show window is a fine thing for the electric light company, as it advertises electric lighting, but does not advertise the goods in the window because it is so hard to see the goods past these border lights. He points out to customers that if a display of goods rather than simply a display of light is the thing wanted, lights must be concealed in reflectors at the top and sides of the window.

The Patent Law Situation.

We have received the following comments from a prominent patent attorney relating to the suggestions contained in a letter by Mr. Ludwig Gutmann on "The Patent Law Situation," which appeared in the issue of August 26:

1. I take no stock in any criticisms that are made as to the competency of our Federal judges to deal with the intricacies of patent litigation. In the course of a forty-year practice I have argued patent questions before some seventy-five or eighty judges, and in all parts of the United States east of the Missouri River. Among them I have found only two whom I considered incompetent—one because he was color-blind as to mechanics generally; he was made so and couldn't help it, and the other because he was incompetent to decide anything. One is now dead, and the other resigned.

Of course, judges sometimes make mistakes; but who does not? Taking it by and large I think that our Federal judges make as few mistakes in patent cases as in any other class of cases; that is, in proportion to the amount of litigation in each.

It is also probably true that mechanical experts make quite as many mistakes as any other class of men. Certainly they differ in their opinions and conclusions quite as frequently as any, and when they differ one side or the other must be mistaken.

The Patent Office already has a quasi sort of a court, a Board of Appeals, made, theoretically at least, of three of its best experts, for the hearing of appeals from the decisions of examiners. It is a not infrequent occurrence that two of these three experts decide one way, and the third the other way.

2. Nor do I take any stock in what is said as to the persecution through unjust patent litigation, of small manufacturers, by powerful corporations. That such things are done, I do not deny; but in my observation and experience the very large majority of the persecution is the other way. It is a not-infrequent occurrence that owners of fraudulent patents bring unjust suits expressly to extort money from wealthy defendants; and also that parties with little capital and no responsibility enter a field of business wherein, under patent protection, somebody else has made a great success; then being justly enjoined, a howl is raised about persecution.

3. I regard it as unfortunate that the final decision in patent causes in the United States is divided between nine courts, even though all are competent. But even this is better than the condition of things which previously existed, and is not as bad as I feared it would be. Still one court of final authority, properly constituted, would, in my opinion, be preferable. The "Patent Court of Appeals"

bill, recently pending in Congress, though not wholly free from objection, ought to be taken up and enacted into a law.

4. Much of the evil complained of in connection with patent litigation, would be corrected by the court itself, if we had judges enough to do the work as it ought to be done. We need about fifty per cent more judges, and their pay should be doubled.

5. Mr. Gutmann's suggestions 1, 2, 3 and 4 as to the judicial use of experts, while perhaps very good in theory, is utterly impracticable. Good experts cannot be got to do judicial work so long as private practice pays so much better. It is also a fact that the best experts are either privately retained or have private interests, and therefore are not available.

6. Mr. Gutmann's 5, if I understand it, proposes to carry patent litigation into the Patent Office. This is also impracticable. The Patent Office already has more work than it can manage, and do it as it ought to be done. In fact, Patent Office work should be lessened if it were possible to do so, instead of increased. A Patent Court for litigated cases administered by the Commissioner of Patents, would very soon become a public nuisance.

Also it has been the policy of our government from its organization to keep the judiciary department entirely separate from the executive. The Patent Office belongs to the executive, and exercises no judicial functions except such as are absolutely necessary to the performance of its executive work of issuing patents. The same rule prevails in all governmental departments. After a patent is issued all questions arising thereunder go to the judiciary, and to a judiciary which is wholly independent of departmental interference or control. Congress will never agree to make it otherwise, and it is a waste of time to talk about it.

7. The same considerations apply to Mr. Gutmann's 6.

8. The 7th is all right, omitting "By the heads of departments or."

9. These are only a partial statement of the objections to Mr. Gutmann's suggestions. This whole subject has been repeatedly threshed out by the parties who know most about it; and the "Court of Patent Appeals" bill is generally regarded as the best remedy now available.

Milwaukee Street Lighting Contract.

The city council of Milwaukee is in a state of turmoil over the renewal of the contract for street lighting with the Milwaukee Electric Railway & Light Company. The municipal ownership bee is buzzing in the bonnets of some of the city fathers, which complicates and hinders the settlement of the matter. The company's contract expires December 15, and John I. Beggs, president and general manager of the company, has indicated very positively his unwillingness to continue lighting the city after that time without some kind of a contract as the city officers would have no authority to pay for light furnished without a contract. As a result of this very reasonable and natural stand, some of the more rabid aldermen are ranting about Mr. Beggs' "threats" to put the city in darkness, and one is even quoted as favoring such a state of affairs to show the people what sort of a dreadful creature Mr. Beggs is. These things are wearisome to good citizens. The city has been made an offer to light the streets for a term of years by a new corporation called the Municipal Electric Lighting Company, which proposes to establish a plant for street and commercial lighting and turn it over to the city at cost at the end of fifteen years.

Electric-Steam Competition in England.

United States Consul Murat Halstead, of Birmingham, England, in a recent report, speaks of the steam-electric traction competition in that country. He notes that the chairman of the Great Eastern Railway, at its 86th half-yearly meeting, complained of the competition of electric railways. The Great Northern seemed to have suffered more than other companies by electric street car competition. They carried 350,000 fewer passengers in York, and though they carried 400,000 more in the London district they had received less money for doing so. Of the adverse influences from which the British railways have been suffering, increased taxation demands from local authorities, war abroad, and new forms of competition, the latter the *Times* considers the most serious because in order to correct it "a graduated transformation of existing methods of haulage seems inevitable. The future is with electricity as an agent of transportation, although at present its application to long-distance traffic has not become practical. In the meantime a beginning will probably have to be made with short-distance business by providing electrical power on sections of the various systems. Several companies have been trying more or less successful experiments with motor cars on short lengths of line, a measure which may be regarded as a half-way house to the use of electricity. It seems to us that in large cities served by more than one company whose directors are turning their minds to this problem it would be well, if possible, to work together, by erecting joint power houses, the cost of supplying current on a large scale being less than when it is produced in smaller quantities. No difficulty has been found in erecting joint stations in Nottingham and elsewhere with capital guaranteed by the companies concerned, and the principle could surely be applied to joint electrical works."

The chairman, at the half-yearly meeting of the Midland Railway Company, also explained that there had been fewer short-distance passengers in consequence of electric street railway competition, which is very keen.

Electrical Engineers of the Times—XXXVII.

MR. PETER JUNKERSFELD.

Peter Junkersfeld was born October 17, 1869, near Champaign, Ill., where his boyhood was passed on a farm. He attended common school until the age of 14 and then followed an inclination which led him to engage in various mechanical pursuits. During the winter months of 1888-89 and '90 he prepared for entrance to the University of Illinois, where he matriculated in 1891 and was graduated from the electrical engineering course in 1895.

Having had some miscellaneous experience in steam engineering, refrigeration and similar work, he concluded upon graduation to complete his mechanical knowledge by engaging for a further period in practical work. He accordingly entered the employ of the Chicago Edison Company in October, 1895, beginning as machinist's

MR. P. JUNKERSFELD.

helper in the Harrison Street Power Station, where he remained for two years, securing in this time an excellent practical training for his future career. In December, 1897, he entered the engineering department of the same company, becoming a draughtsman, and the following year was promoted to chief draughtsman. In 1899 he became assistant mechanical engineer, and in 1903 assumed his present position of head of the engineering department of the Chicago Edison and Commonwealth Electric Companies.

As will be seen from the above, Mr. Junkersfeld in the past ten years has had opportunity to study the engineering and operating sides of central station work in every detail, and during the past eight years he has been closely identified with all the engineering and construction work of the Chicago central station system.

The Chicago Edison Company was one of the first central-station companies to install rotary converters, centralize its principal generating equipment and thus effect an economy which made possible its great increase of service in the business and central districts of the city, to which territory this company is limited. The

outlying districts of Chicago were formerly supplied by a large number of small companies operating systems of several different voltages and frequencies. The amalgamation of these small companies resulted in the organization of the Commonwealth Electric Company, which in 1899 built the 56th Street Station and standardized the entire distribution for all of the outlying districts of the city and making the first extensive application of the four-wire three-phase, 50-cycle system of primary distribution.

The affiliation of the Edison and the Commonwealth companies led to the further concentration of the generation of electrical energy for lighting and general power purposes for the entire city of Chicago, and included the development of an extensive 25-cycle transmission system with many sub-stations for railway as well as for general work, and recently the erection of the well-known Fisk Street Turbine Station. In all of the engineering work connected with this development, Mr. Junkersfeld took a leading part.

As a result of this experience, Mr. Junkersfeld has made special reports on several central station problems, one of the most important being his connection with an investigation and report on the central-station systems of St. Louis. The recommendations then made are the basis of the extensive reconstruction work still under way in that city.

Mr. Junkersfeld is an associate member of the American Institue of Electrical Engineers and also a member of the Western Society of Engineers. He has presented papers before both of these societies and also before the Association of Edison Illuminating Companies.

Radioactive Water.

At the recent annual meeting of the American Electrotherapeutic Association, Dr. W. J. Morton presented a paper giving the result of investigations having in view to render water radioactive. While pointing out that in a number of cases water has been found radioactive in a natural state, no success had been met with in imparting artificially this property to water. Dr. Morton, however, succeeded in doing so by immersing powdered pitchblende in water. The paper includes two tests made at Columbia University by Dr. George B. Pegram and Mr. L. D. Case, which showed that the water thus prepared by Dr. Morton possessed the radioactive properties of the three elements: radium, thorium and actinium. There was but a slight decrease in the activity of the water when the bottle containing it was tightly corked, but any left standing in open containers lost its activity after several hours. Water contained in a bottle also lost its activity upon boiling.

Among the conclusions drawn from the tests were that the activity of radioactive water, unlike that of radioactive solids, is independent of the weight, and that the activity increases with the amount of free surface exposed. In his paper Dr. Morton points out what curative properties may reside in radioactive water. In general it has an active tonic effect, produces a regular action of the bowels, and has a special action on cancer, external and internal. An account is given of a case of rodent ulcer on the right cheek which was rapidly cured by a doseage of radioactive water and quinine, 5 grains daily.

CURRENT NEWS AND NOTES.

TOLEDO (OHIO) MUNICIPAL PLANT.—At Toledo, Ohio, during the recent election, the proposition to bond the city for $470,000 for a municipal lighting plant was lost by 195. There were 15,215 votes cast for it and 7,901 against, a total of 23,116. To carry a two-thirds vote, or 15,410, would have been necessary.

TELEPHONY IN PHILADELPHIA.—One of the cities gaining rapidly in telephonic facilities is Philadelphia. In spite of the fact that there is an active opposition independent company, the Bell system gained 5,378 instruments in October, has increased 31,582 since January, and has now connected 114,079. This is not far from the figures of Chicago.

WIRELESS TO PORTO RICO.—A dispatch from San Juan, Porto Rico, states that the De Forest wireless station there on November 18 received the first complete message from Key West. This, the dispatch adds, is a record distance for wireless transmission, and assures the success of the station established at Porto Rico by the Navy Department.

N. E. L. A.—President Blood of the National Electric Light Association has reappointed the committee on Rates and Costs which made report to the Denver convention. The committee consists of Messrs. Charles L. Edgar, chairman; Louis A. Ferguson, Samuel Scovil, Frank W. Frueauff, P. G. Gossler and R. S. Hale. Mr. Geo. W. Brine, who was a member of the committee last year, declines on account of illness to serve again this year.

CHICAGO A. I. E. E.—Mr. Kempster B. Miller gave a talk illustrated with stereopticon views before the Chicago Branch of the A. I. E. E. November 14, on "Fire Alarm Telegraph Systems in Great Cities," describing especially the fearful and wonderful condition of the fire alarm system of New York City, which he spent the greater part of the past summer investigating. An abstract of his report on this subject was published in the ELECTRICAL WORLD AND ENGINEER of October 14, 1905.

OUTPUT OF CURTIS TURBINES.—In a paper read last week before the annual meeting of the Society of Naval Architects and Marine Engineers on the "Marine Applications of the Curtis Steam Turbine," Mr. Charles G. Curtis stated that the total number of turbine units thus far shipped by the General Electric Company is about 290, and that 200 are now on order. The units vary in capacity from 15 kw to 8,000 kw, more than 60 per cent ranging from 500 to 8,000 kw.

TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.—The 39th annual meeting of the Telegraphers' Mutual Benefit Association was held in New York on the afternoon of November 15. The report of President Belvidere Brooks showed the association to be in a prosperous condition. The sum of $20,000 was carried to the reserve fund last year, the fund now amounting to $247,941.71. Mr. Brooks was re-elected president; W. H. Young, first vice-president; Charles P. Bruch, second vice-president; M. J. O'Leary, secretary; and A. R. Brewer, treasurer.

SEVEN HUNDRED MILES TRANSMISSION.—Mr. Ralph D. Mershon has been retained by the African Concessions Syndicate, Limited, of London, in connection with the proposed development of power at Victoria Falls on the Zambesi River, Rhodesia, South Africa, and its transmission to Johannesburg and the Witwatersrand, for use in connection with gold mining. The distance of transmission will be about 700 miles. Mr. Mershon has just returned from a flying trip to Europe, made for the purpose of consultation relative to this enterprise.

STIMULATING PLANT LIFE.—It is proposed by the U. S. Department of Agriculture to test the effect of electricity on plant life and growth. A laboratory is being equipped in the division of pathology to conduct experiments in the growing of plants by the aid of an electric appliance. The experiments will be based on the theory that the growth of vegetable matter, which ceases at sundown, will continue through the night if proper artificial light is supplied to stimulate the developing powers of plants. Experiments will be made largely on lettuce, which has been found peculiarly susceptible to electrical influences. The plants will be kept under a strong light during the night, with a view to having the electrical rays take the place of the sun. It will probably take a year or more before actual results are obtained from the experiments.

LECTURES AT THE UNIVERSITY OF MINNESOTA.—Mr. E. P. Burch is giving a course of four lectures on "Heavy Electric Railroad Work" before the Senior engineers at the University of Minnesota. The subjects of the several lectures are: "The Physical and Financial Advantages of Electric Traction for Heavy Railway Work"; "The Speed-torque Characteristics of Steam Locomotives"; "The Speed-torque Characteristics of Electric Locomotives," and "The Physical Data for the Electrical Equipment for Operating a Division of a Transcontinental Railway." These lectures, which supplement the regular class room course in electric railways, are based upon the investigations made by Mr. Burch for some of the Western railway companies which are considering the feasibility and desirability of electric traction upon certain divisions of their main lines.

LONDON POWER PLANT.—A cable dispatch from London of November 14 says: "The London County Council this evening decided to introduce a bill in Parliament under which the Council will construct a plant to supply all the electric energy for London and the suburbs. The cost is estimated at $40,000,000."

TELEGRAPH WIRES UNDERGROUND.—It is stated from Philadelphia that the Pennsylvania Railroad has drafted plans for placing its telegraph lines underground. The first conduit will be laid between that city and Lancaster. The next work will be on the trunk lines between Philadelphia and New York, where much trouble has been experienced from wind and snow every winter. The line between Philadelphia and Washington will be taken up as soon as the New York division is finished. Inasmuch as the Postal Telegraph Company parallels the Pennsylvania system east of Pittsburg and Erie, it will co-operate in the tests.

POOR'S MANUAL FOR 1905.—The thirty-eighth annual number has been issued, for 1905, of that valuable standard publication, *Poor's Manual.* It contains the statements of all the steam railroads in the United States and Canada and of the principal roads in Mexico, the statements of all the street railway and traction companies in the United States, the statements of the leading industrial corporations and organizations auxiliary to railroad interests, and statements showing the finances and resources of the United States, the several States, and the principal towns and cities in the country. For reference purposes this statistical compendium cannot be excelled. There are 1,620 pages.

NEW YORK STATE LIGHTING.—Reports received by the State Commission of Gas and Electricity show that municipal lighting plants are maintained in Herkimer, Hamilton, Skaneateles, Boonville, Westfield, Mohawk, Ilion, Holley, Dunkirk, Cape Vincent, Spencerport and Dryden. Green Island also has its own lighting plant and supplies the village of Waterford. The commission is making a canvas of the gas and electric light and power companies of the State, and each company, municipality and individual engaged in the business of furnishing gas or electricity for light or power is asked to give certain details of stock and bond issues, amount invested in the plant and capacity and price charged for public and private lighting and power purposes. About 150 reports have been received.

TELEPHONY IN DETROIT.—The City of Detroit has had a lively experience with rival telephone systems, and after successive consolidations the same old question of a new company is up again. There is considerable diversity of opinion locally on the subject. "In my opinion, the new system will never be built," said C. F. Bielman, president of the Board of Commerce. "Detroit does not need two telephones half as much as it needs two street railways or two water works plants. We are fond of municipal luxuries in Detroit, but we cannot stand too many of the unnecessary things. I do not believe that the administration nor the people of this city will permit any local or foreign corporation to impose a new telephone plant upon us, string wires, erect poles and tear up our streets. We can take care of ourselves against any local corporation."

HEATING A MAN-OF-WAR.—The night of the recent ball on the British cruiser *Drake* in the Hudson River was bitterly cold, and attempts were made to heat the ship with hot shot in cauldrons of sand. Nobody seems to have thought of putting electric heaters into circuit with the ship's plant, instead of some of the superabundant lights. Dr. Park Benjamin, in a letter to the newspapers, remarks: "What a pity it is that Rear Admiral Battenberg's ball should have been marred, as it was, by the cold, merely because his advisers here failed to discover that abundant electric heaters were available and that a branch from the nearest electric main, which the electric lighting company could have provided, would have given all the current needed to make the ship comfortable. It was found entirely practicable recently to heat temporarily in this way the wide piazza over 100 ft. in length of a residence located in the northern part of this State during extremely cold weather in mid-winter. No request appears to have been made of the electric lighting people to deal with the easily met conditions existing on the *Drake,* although it was known here long ago that this ball was contemplated, and cold snaps in November are certainly to be expected."

ALL TRUSTS BANNED.—At St. Louis on November 16, at the session of the Citizens' Industrial Association of America, resolutions were adopted expressing approval of the investigations and prosecutions by Federal and State authorities of certain great trusts of capital, and also expressing the belief that certain associations of organized labor, or labor trusts, also should be investigated, and, if found to be illegal, prosecuted also. The association reaffirmed these principles: (1) The open shop, demanding only good faith and fair dealing; it discriminates against neither union nor non-union labor. (2) The freedom of the apprentice and the right of the individual to have a trade and to follow it. (3) The right of private contract, with equal obligation upon employes and employe. (4) The right to work, limiting the hours of labor, whether of brains or of the hand, is a matter of mutual agreement, not a subject for arbitrary legislative enactment. (5) The enforcement of the law. The election of officers resulted as follows: President, C. W. Post, Battle Creek, Mich.; first vice-president, J. W. Van Cleave, St. Louis; second vice-president, F. C. Nunemacher, Louisville; third vice-president, A. C. Marshall, Dayton, Ohio; secretary and treasurer, Major A. C. Rosencranz, Evansville, Ind.

CARNEGIE TEACHERS' FOUNDATION.—A meeting was held last week of college presidents from fourteen States and the Dominion of Canada, at the house of Mr. Andrew Carnegie in New York, to determine conditions for the Carnegie Foundation of $10,000,000 for the support of superannuated, retired and disabled teachers of the universities, colleges and technical schools. The available income will be about $500,000. There are already hundreds of applicants. The trustees elected President Eliot, of Harvard, as chairman of the Board of Directors, and President Harper, of the University of Chicago, as vice-chairman. President Thwing, of the Western Reserve University, was chosen secretary. It was decided that the home office of the foundation corporation should be in New York City. It was determined by a unanimous vote to leave the active management of the fund to an executive committee, with the president of the Board of Trustees as ex-officio chairman. President Henry S. Pritchett, of the Massachusetts Institute of Technology, was elected as the chief executive, and the executive committee was named to consist of President Nicholas Murray Butler, of Columbia; President Woodrow Wilson, of Princeton; Provost Charles C. Harrison, of the University of Pennsylvania; President Alexander C. Humphreys, of Stevens Institute; Frank A. Vanderlip, vice-president of the City Bank, and Robert A. Franks, president of the Hudson Trust Company, of Hoboken, who is Mr. Carnegie's private banker. T. Morris Carnegie was named as treasurer.

MARCONI AND ITALY.—It is stated that owing to a recent agitation in some of the opposition papers of the Italian press against the contract between the Italian Government and Mr. Marconi, which grants an exclusive license to the Marconi wireless telegraph system for fourteen years, Mr. Marconi has written to the Italian Minister of Posts and Telegraphs offering to consider the agreement as cancelled, thus relieving the Italian Government of all obligations. A translation of the reply of Minister Morelli Gualtierotti is as follows: "The tenders for work at the Coltano Station will be invited at Pisa on October 18. The ministry, in thus putting into execution the bill twice approved by parliament, is also convinced of the value of the conditions entered into and also grateful to the illustrious Italian who generously conceded to his country the use, without compensation, of the extraordinary fruits of his genius. I beg you not to concern yourself about any discordant opinion, which certainly does not reflect either the feeling of the country or that of the government." This reply confirms the policy of the Italian Government in adopting wireless telegraphy and refusing to permit compulsory exchange of messages between it and other systems. As compulsory intercommunication was the main point raised during the preliminary wireless telegraph conference held in Berlin two years ago at the instigation of the Kaiser, the strong attitude persisted in by the Italian Government will have a most important effect on the deliberation of the next conference, which, it is rumored, will be held at Paris. The Italian government has had the largest practical experience with wireless telegraphy and its renewed decision in favor of a single system will, it is claimed, carry exceptional weight and may influence the attitude of our own and other governments.

JERSEY UNDERGROUND ROAD.—A new project is an underground electric railway to be constructed from Jersey City to Newark, 8½ miles long, and tunneling the Passaic River. The road, if built, will start in Jersey City on the Pennsylvania Railroad property, and pass through Kearney and Harrison.

ELECTRIC COOKING IN FLATS.—It is stated that in some new apartments, or flats, in London, to be built on the site of Gloucester House, the town residence of the late Duke of Cambridge, all the cooking and heating is to be done by means of electricity. Why does not some enterprising apartment builder in New York try this plan?

NEW SHANGHAI CABLE.—A cable has just been completed by the German-Dutch Company between Guam, Yap and Shanghai, connecting at the first island with the Commercial Pacific cable system. The new cable obviates the use of the route via Manila for messages from this country to China points and affords direct communication with Shanghai.

HIPPODROME LIGHTING.—A new spectacular piece at the New York Hippodrome is to be called "A Society Circus." The climax will present a lake into which many fountains will play. Four hundred thousand candle-power of electric light will be used for illumination. Two dolphins with 20-ft. tails, conch shells, mermaids, griffins, and an 80-ft. serpent are among properties to be employed. Four searchlights will be used.

ITALIAN ELECTRIC RAILWAYS.—A new company under the name "Officine Elettro-Ferroviarie" has been organized in Milan, Italy, with 1,500,000 francs capital, which is to be increased to 4,000,000 francs. Its purpose is to manufacture cars for steam and electric railways, also electrical machinery. Dr. George Finzi, well known in the field of single-phase railways, has been elected general manager, and Messrs. Hugo and Emil Tallero are superintending engineers.

CANADIAN MUNICIPAL RAILWAY.—A Canadian correspondent says that the city council of Guelph, Ont., a couple of years ago, undertook to run the street railway as a municipal venture and, although it is a city of 13,000 in population, it claims to have made a success of the enterprise. Last year there was an apparent profit of $2,000. The street railway is managed by a commission of five members, consisting of the Mayor, one alderman and three private citizens. These serve without salary and are chosen annually. Under them is a general manager, who receives a salary of $1,000 per annum for his services.

WIRELESS TO DETECT ORES.—Articles of incorporation have been filed at the office of the Secretary of State of Colorado for the Syntonic Wireless Engineering and Mining Company. The company is capitalized at $50,000, and will have its headquarters in Boulder. The company will try a new system of finding precious metals. A machine, from which the company takes its name, has been invented by A. W. Hunter, of Boulder, who says that it will locate bodies of ore. "The machine is electrical, but does not depend upon wires, being like a wireless telegraph instrument." When taken into a mine, it is said, the indicator will show the location of ore, as well as measuring its distance.

SINGLE-PHASE WORK.—With regard to its single-phase electric railway work in Europe, the Allgemeine Elektricitäts Gesellschaft, of Berlin, furnishes the following list of work that it has carried out or has now in execution: "Spindlersfeld, 5 110-hp motors, total 550 hp; Swedish State Railways, 5 110-hp motors, total 550 hp; Hamburg City & Interurban Railway, 161 115-hp motors, total 18,515 hp; compressor motors for the foregoing installations, 57 3-hp motors, total 171; Stubaitalbahn, 20 40-hp motors, total 800 hp; Borinage, 40 40-hp motors, total 1,600; mining locomotives for the Menzel shaft, 3 40-hp motors, total 120 hp, making a total of 22,306 hp of single-phase motors." It was probably not suspected that anything like this record had already been attained.

POWER PLANT PHONETICS.—An electrical engineer inquiring by circular letter recently as to the facilities for charging electric automobiles in the country districts of Michigan, received a reply from the manager of a combined electric light plant and grist mill. It is given herewith *verb. et lit*: "Your lader datat Oct. 31st razivet. Yu wont to no abaut charging storage batteries for Automobile. I harv gat hiar 220 Volts Deract Cornt marchian I am nat fitad op yat to du dat. I dink it kan bi don by a wari lidle xpans to du dat I wold haf to harv the apratos to konact op and cot daun the Volts to 110 Volts the Plant is rannig 18tin Hours awri dai the rate is hiar 5c for a 1000 Watts for lighting bildings yusing Walter Power the yier raund. Plandy zurplas Power an the Dainamo and Watter Wiells."

THE GALERIE DES MACHINES, which has long been an important part of the great expositions in Paris, and has contained the electrical and mechanical exhibits, is likely to be brought to New York. The circus firm of Barnum & Bailey announce the purchase of the Galerie. This mammoth structure has been on the site of the exposition for 27 years. It is of steel, measures 1,800 ft. in length, with a uniform height of 110 ft. It is Mr. Bailey's plan to have the building taken apart, bring the steel to this country and erect a building somewhat larger than the original. He says it will be capable of seating 26,000 people. Options have been obtained on a tract of land on West One Hundred and Sixtieth Street. If these plans go through the projectors expect to have their building up and ready for occupancy by the fall of 1908. The estimated cost of removal, transportation and erection of the building is $5,000,000. The projectors intend to have the reconstructed Galerie des Machines appear without post or pillar. As it now stands it is constructed of immense steel arches supporting roof and sides, terminating at their base on granite foundations.

ENTERTAINMENT AT NEW ORLEANS.—On November 7 Sanderson & Porter, contracting engineers of New York, entertained their friends and engineers at a banquet at the St. Charles Hotel, New Orleans, followed by a theatre party at the Tulane Theatre. The firm are consulting engineers for the New Orleans Railway & Light Company and have been the constructing engineers and contractors for the company's numerous improvements and extensions. Several members of the firm were present, with officials of the New Orleans Railway & Light Company, including President Foster and Vice-president Joseph H. De Grange. Mr. Blossom represented Sanderson & Porter and acted as host and toastmaster. He stated in his address that the dinner was given in testimony of the loyalty and devotion of the employes of the firm in the accomplishment of the work on hand during the prevalence of yellow fever in New Orleans, as many of them were from other States and not immune. Speeches were made by Mr. Blossom, Colonel De Grange and Mr. Foster, who complimented the engineers on the successful issue of the work undertaken, the starting of the new underground lighting system of more than 2,700 new arc lamps, and putting into operation the new power station at Market Street.

ENGLISH MUNICIPAL TROLLEYS.—In a report on British tramways United States Consul Williams, of Cardiff, Wales, calls attention to the fact that a large part of the English people favor the municipal ownership of all important public utilities, but submits figures to show that it is far from being as successful as its friends would wish. He says: "The schemes cover a multitude of utilities, some almost purely social, but the largest items have been spent on power plants and electric trams. The rate payers do not find the last-named profitable in all cases. For instance, the Cardiff Corporation Tramways, representing a capital expenditure of $3,530,048, returned a net profit of only $101.60 for the year ending March 31, 1905. This poor showing may be attributed to two causes, excessive costs and low income. In the matter of costs, a good showing was made so far as working expenses were concerned, for although there is a payment of time and a half for Sunday work and double time for holidays, they amounted to only 5.948 pence per car mile. Perhaps the principal cause of the reduced income in 1904-5 was bad trade. This was an unexpected experience for the advocates of public ownership, and the lesson should be taken to heart by Americans. It appears that tramways are the first municipal utilities to feel the bad effects of hard times. Depression in trade has led to a reduction of wages in many industries, and the tramway receipts have registered these reductions like a barometer."

Niagara Power in the Gorge.—II.

PORT DAY, with its frontage of 800 ft. on the upper river, the basin 1,000 ft. long and 70 ft. wide on the brink of the Gorge below, and the canal 4,400 ft. long and 100 ft. wide between them, are the most important elements in the system of the Niagara Falls Hydraulic Power & Manufacturing Company.

Among hydraulic developments about Niagara Falls the one under consideration is unique. Of the six great electric plants at the Falls, five operate with tunnels or pipe lines, and only in the one of the Hydraulic Power Company is the water conveyed entirely by canals. This canal, by cutting across the business section of the city, follows the shortest possible course between the upper and the lower river on the New York side, apart from the State Reservation. Duplication of this canal would now be entirely impracticable because of the great value of the necessary real estate, and the canal owes its existence to the fact that Niagara Falls was only a small village when the right of way was obtained, in 1852.

At Port Day, on the upper river, the canal is about 400 ft. wide at its head, and it narrows to a width of 100 ft. in a distance of 500 ft. from the inlet. From the upstream bank of the canal, at its head, a breakwater runs diagonally down stream for some 375 ft., and from the outer end of this breakwater an ice boom is stretched to the down-stream side of the canal inlet. The combined breakwater and boom thus completely encircle the head of the canal, and this construction has an important bearing on the freedom of the canal from floating ice. As ice comes down the river it first strikes the breakwater, and is deflected out into the stream. Then any ice that tends to float into the canal at points down river from the outer end of the breakwater is stopped by the boom. Two openings in the breakwater are also closed by booms.

The depth of the canal at Port Day is 14 ft. below low water line, and excavation now in progress is intended to carry its entire length of 4,400 ft. down to a corresponding depth. Most of the canal bed lies in rock, so that this excavation is slow and expensive. On a large part of its course the canal has masonry walls, and it is crossed by numerous bridges. The width of 100 ft. is maintained over the entire length of the canal from Port Day to the hydraulic basin at the top of the cliff above the Gorge, and this basin is 70 ft. wide along about 680 ft. of its original length of 850 ft., the width of the remainder being about 30 ft. In direction this basin is nearly at right angles with the lower end of the canal, and parallel with the face of the cliff and with the river.

The capacity of this canal to deliver water in the basin at the top of the cliff is much greater than the maximum demand of the turbine wheels that operate the present electric station in the Gorge below, and the Niagara Falls Hydraulic Power & Manufacturing Co. has begun the construction of another station with a capacity of about 100,000 electric horse-power.

The new station will be located at the edge of Niagara River in the Gorge, a few hundred feet further down stream from the older station. In order to bring water from the canal to the top of the cliff above this new station, the basin has been extended about 150 ft., giving it a total length of 1,000 ft., and from the north end of this extension a forebay that will have an ultimate length of about 590 ft. is being excavated. Some 350 ft. of the length of this forebay will run along the top of the cliff parallel to its face, and from this part of the forebay the steel penstocks will drop down the face of the cliff to the electric station.

Just before the water reaches that part of the forebay where the heads of the penstocks are located, it passes an ice run whose head is 50 ft. wide, and any ice diverted into this run moves down the cliff into the river. Near the point where the forebay joins the canal basin, and where it has a width of 50 ft., a set of three head gates, each 15 ft. wide, is provided to shut off water from the forebay. This width of 50 ft. is uniform from the basin to the head wall of the forebay, but back of that wall the width starts at 67 ft. and gradually narrows.

FIG. 3.—ICE BOOM AT PORT DAY.

Both the excavation for the extension of the basin and for the forebay, as well as that for the power station in the Gorge below, is in limestone and shale, and such of the loosened rock as is not wanted for masonry construction is simply dumped into the river, in front of the station site. It is somewhat novel to see thousands of tons of excavated rock dumped into the tail race of a water-power plant, but the great depth of Niagara River, believed to be about 200 ft. at this point, is said to warrant such a course.

Between that part of the forebay where the penstocks enter and the outer portion, it is crossed by a bridge from which a solid steel boom drops to a line 10 ft. below the water level. Any floating ice will be deflected by this boom into the run above mentioned. Mean low water level at the rack in the inner forebay will stand at elevation 557 ft. above sea level, three ft. below Niagara River at Port Day, 22 ft. above the forebay floor, and 17 ft. above the centers of the steel penstocks. Over its natural foundation of limestone the forebay has a layer of concrete one foot thick, which joins the head wall of the same material. In height this wall measures 31 ft., its bottom width is 24 ft. 7½ in., at elevation 560, the top of the rack, the thickness is about 14 ft., and at the top, elevation 565, it is 9 ft. The toe of this wall is about 5 ft. back from the edge of the cliff, along a part of its length. On the forebay side of the

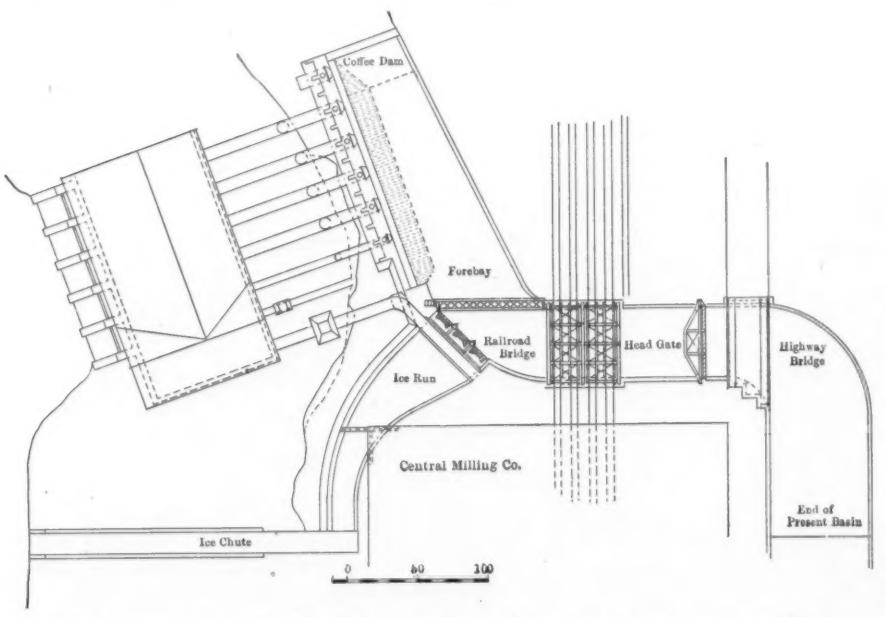


FIG. 1.—GENERAL PLAN OF NEW STATION OF NIAGARA FALLS HYDRAULIC POWER & MFG. CO.

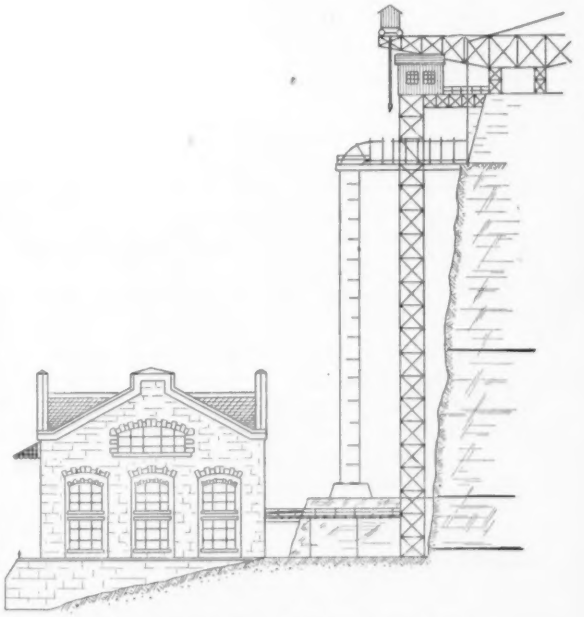


FIG. 2.—ELEVATION OF NEW STATION.

head wall is the ice rack, rising 25 ft. from the bottom of the forebay and making an angle of about 33 deg. with the vertical. This ice rack will have a roof over it so that it may the more readily be kept clear of ice, and for raising the racks there will be an overhead hoist.

In the concrete front wall of the forebay the heads of 14 main penstocks, and of several smaller penstocks, will ultimately be fixed, and these penstocks will run down the face of the cliff to the turbine wheels in the Gorge below. With the section of the forebay and power station now under construction from penstocks for the wheels of the main generators, and one penstock for a pair of exciting dynamos, will be used.

Each of the main penstocks has a diameter of 8.5 ft., and the diameter of the small penstock is 5 ft. The head of each main penstock is imbedded in the forebay wall for a horizontal length of about 10 ft., and the penstock has a length of about 24 ft. beyond the outer face of the forebay wall before it turns at right angles and drops to the power station. A gradually contracting entry is formed in the concrete from the forebay side of its front wall to the head of each penstock, the length of this entry way being about 8 ft., and a circular iron gate operated from the top of the wall closes the mouth of each penstock. Beneath the head of each penstock there is a drain pipe, and connected on the power house side of its gates is a by-pass. From the front of the forebay wall to the cliff side of the power house the total horizontal run of the steel penstocks is 86 ft., and the vertical drop about 169 ft.

The design of the power house calls for a one-story building with walls of gray limestone and a slanting roof. In plan the complete power house will measure 350 ft. long, and 93 ft. wide. For the section of the power house now under construction the length is 168 ft. Between the base of the vertical cliff and the power house the distance is 50 to 80 ft., and the front of the house sets 22 ft. back from the edge of Niagara River. Access to the power house from the top of the cliff is to be had by means of a bridge over the ice run, and an elevator shaft down the face of the cliff. Under the generating station the masonry foundations are so designed that there is an arched tail race beneath each pair of main turbine wheels, and beneath the two pairs of turbines that drive two exciting dynamos. Each pair of turbines sets with its horizontal

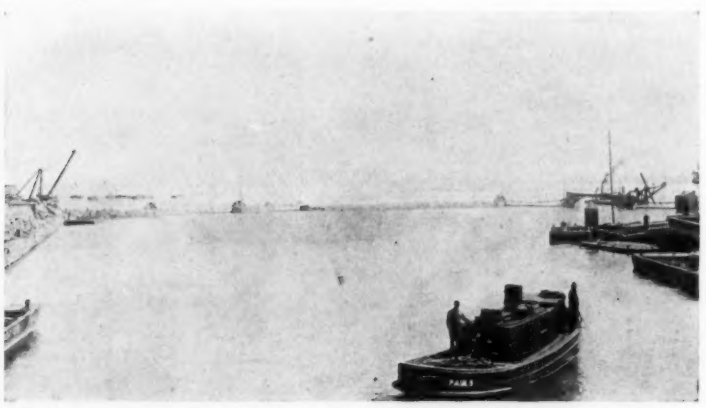


FIG. 4.—HEAD OF CANAL AT PORT DAY.

shaft at right angles to the longer sides of the station, so that water entering the station by way of the penstocks passes underneath that part of the floor where the electric generators are located on its way to the river.

To give the tail water a more constant level than the river has in front of the station, and to make sure that the lower ends of the draft tubes will be constantly under water, each tail race under the station discharges over a dam that is some 3 ft. above the normal river level. From the crest level of these tail race dams to the floor of the power station the vertical distance is about 21 ft., and to the centers of the main turbines about 24 ft.

Along its greater length the main floor of the station is divided into two parts by a masonry partition. That part of the station on its cliff side is 38.5 ft. wide and contains the horizontal turbine wheels, and that part of the station on its river side is 45.5 ft. wide and contain the electric generators and switchboard. Each penstock enters one end of its wheel case, and the two wheels in each case discharge into the tail race through a single draft tube. The case containing each pair of main turbines has a diameter of 13 ft., and its wheels are designed for 300 revolutions per minute under a net head of 210 ft.

From each pair of main turbines a horizontal shaft runs through the dividing wall of the station into the part on its river side, and there connects with the shaft of a 5,000-kw alternator. A short section of each shaft which passes through the dividing wall connects with both the turbine and the electric generator by means of flanged couplings. After passing into the station, the 5-ft. penstock divides into two branches, and each of these branches connects with a case containing a pair of turbines. Shafts from these two pairs of turbines go through the dividing wall, and are connected to exciting dynamos.

Each 5,000-kw alternator is rated at 11,000 volts, 25 cycles, three-phase, and will operate at 300 r.p.m. These alternators are of the internal revolving magnet type. The shaft of each is about 17 in. in diameter. It is said that the weight of the revolving magnet of each alternator will be about 50 tons, so that the pressure on each bearing will be about 50,000 pounds. The floor space for each ma-

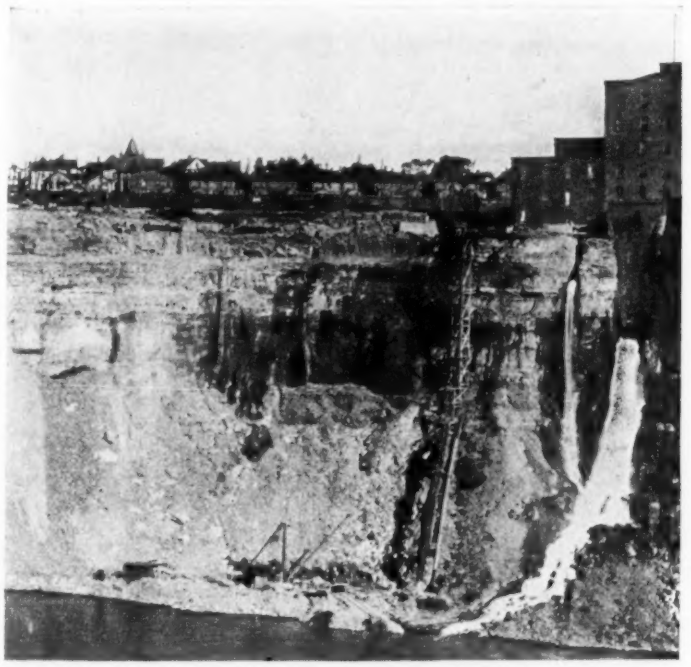


FIG. 5.—EXCAVATION FOR NEW POWER STATION OF NIAGARA FALLS HYDRAULIC POWER & MFG. CO.

chine is 14 ft. parallel with the shaft, and 20 ft. at right angles to it. It is the intention to install 14 of these alternators in the completed station, so that the ultimate capacity there will be 70,000 kw.

It is the plan to locate the switchboard for this station on a gallery or raised plaform next to the river wall, and in full view of the electric generators. That part of the power station now under construction, with a capacity of 20,000 kw in main generators, is expected to be in operation before the end of 1907.

Of the Niagara Falls Hydraulic Power & Manufacturing Company, the owner of this new power plant, Arthur Schoellkopf, is general manager; John L. Harper, chief engineer; W. C. Johnson, consulting engineer; George R. Shepard, assistant engineer; Ross R. Coddington, construction superintendent, and Benjamin F. Lee, electrical superintendent.

Much of the work on the new plant is being done by day labor under the direction of the engineers of the Hydraulic Power Co.

Physical Chemistry at Massachusetts Institute of Technology.

The staff of the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology has, according to *Science*, undergone several changes. Mr. Yogoro Kato, who has been engaged for the past two years in the investigation of the conductivity of aqueous solutions at high temperatures, has accepted a position in the technical high school of Tokio, where he will have charge of the work of electrochemistry. Prof. W. D. Coolidge has accepted a position in the technical research laboratory of the General Electric Company.

The Efficiency of Electrical Power Generating Stations.

BY H. M. HOBART.

STATIONS commonly brought under the above designation should, of course, strictly speaking, be termed "transforming stations," since in such stations a small part of the energy of combustion of the coal or other fuel is transformed into electrical energy. At the same time there is transformed a far larger part of the energy of combustion of the coal into irrecoverable heat energy.

The writer has analyzed the results of a number of such generating stations with the object of determining the efficiency from the coal pile to the outgoing cables. This efficiency will be denoted as the annual overall efficiency of the generating station. Twenty-six of these stations are classified in three groups in Table I, page 902. In each group one-half represents British stations and one-half represents stations outside of Great Britain. None of the stations are situated in the United States, as the data studied did not comprise any such stations. Two considerations controlled the choice of stations for inclusion in the investigation. The first consideration was that the available data should include as many as possible of the facts affecting the annual overall efficiency. The second consideration was that the range of capacities and the average capacity of the British stations should be about equal to the range of capacities and the average capacity of the stations located outside of Great Britain. This selection was made without any reference whatever to the value of the resulting average efficiencies.

Table I on page 902 gives the output of the station for the period considered, in millions of kilowatt-hours per annum. The stations are arrranged in the order of their annual outputs. In this table are also compiled those particulars of each station which could be expected to have a bearing upon the overall efficiency, together with the data necessary for calculating this overall efficiency. The annual input of energy in the form of the energy of combustion of the coal, the annual output in millions of kilowatt-hours of electrical energy, and the annual overall efficiency are likewise recorded for each of the 26 stations.

TABLE II.

Class.	Great Britain (B) or abroad (A).	Average output from generating station during year in millions of kw-hours.	Average efficiency of generating station in per cent.
Between 0.9 and 3.3 millions of kw-hours. per year	B	2.0	2.8
	A	1.9	5.2
Between 6 and 13 millions of kw-hours per year	B	9.3	5.8
	A	9.9	6.6
Between 18 and 45 millions of kw-hours per year	B	28.8	7.2
	A	32.6	8.3

In Table II these results are averaged for the British stations and for the stations situated outside of Great Britain.

In Fig. 1 these average results are plotted in the form of curves showing the annual overall efficiency of the generating stations as a function of the millions of kilowatt-hours of annual output.

It is to be regretted that the published returns from generating stations are not more complete. Thus we naturally ask ourselves whether it might not be possible to trace a connection between the overall efficiency and the extent to which electrical storage batteries are employed, but we find that the incompleteness of our data makes this impossible. It is fair to assume that all these stations were operated condensing, although this fact is recorded only in the case of the British stations. In fact, non-condensing stations, when known to be such, were purposely excluded from the comparison. In no case, however, are there records of the average vacuum maintained, nor of the average amount of superheat employed. The comparison of the capital cost and the rate of depreciation would also have been impracticable, and hence one cannot assert conclusively that the one or the other set of generating stations represents the better engineering.

It is, however, quite evident that even the better of the two efficiency curves of Fig. 1 is very low. The efficiency of steam generating sets at full-load frequency exceeds 20 per cent in larger sizes, and the efficiency of a good boiler working at its rated capacity should not fall below 75 per cent. Taking the efficiency of the steam piping at 95 per cent, there is obtained a practicable full-load overall efficiency of the generating station of $0.20 \times 0.75 \times 0.95 = .14$.

The difference between this efficiency and that actually obtained in practice is due chiefly to the circumstances that the plant is run

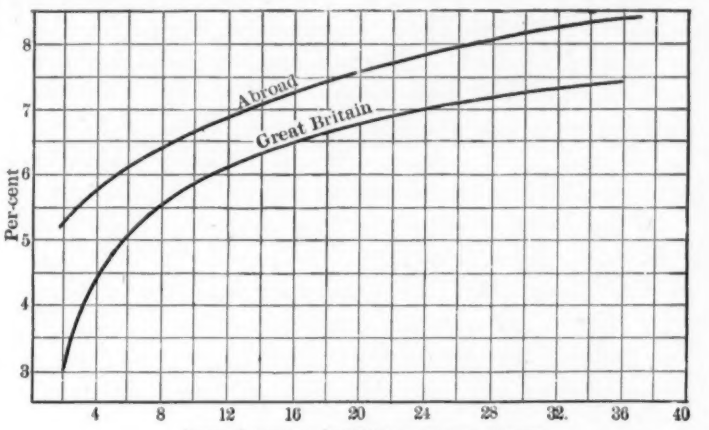


FIG. 1.—OBSERVED TOTAL EFFICIENCY OF GENERATING STATION FROM COAL PILE TO OUTGOING CABLES.

for a large part of the time at considerably less than full load; that fires must be kept under one or more spare boilers; that the boilers and engines are not maintained in this condition of highest efficiency; that the supply of air to the fires is not suitably regulated; that the coal is not uniformly of the calorific value of the samples tested, and to various other detail circumstances.

As shown in Table I, it is not unusual to find large stations with an annual overall efficiency of over 7 per cent.

CAPACITY OF SINGLE GENERATING STATIONS.

As illustrations of the size of modern generating stations, some rough leading data of a number of such stations have been brought together in Table III.

TABLE III.

Name of generating station.	Millions of kw.-hours delivered from generating station per year, during one year or half-year.	Period considered.	Total kilowatts rated capacity of generating sets, excluding exciters and sets for lighting and power in generating station.	Average load during total period considered (based on 24-hour day).	Maximum load during total period considered.	Load factor at out-going mains from generating Station.
Pinkston Station (Glasgow Corporation Tramways.)	23.0	Year ending May 31, 1905.	11,200	2,630	8,520	.31
Shepherd's Bush Station (Central London Railway).	18.1	Half-year ending June 30, 1905.	5,100	2,060	4,000	.52
Ringsend Station (Dublin United Tramways).	8.2	Half-year ending June 30, 1905.	3,600	936	....	..

In Table IV are given rough estimates of the ultimate capacities for which these stations would be suitable with a 50 per cent load factor. To the three stations in Table III there have been added in Table IV the Neasden generating station of the Metropolitan Railway of London, and the Chelsea (Lots Road) power station of the Underground Electric Railways Company of London, Limited. The estimates in these last two cases are, of course, only of the roughest nature, as electrical power has only recently been delivered

TABLE IV.

Name of generating station.	Millions of kw.-hours of annual capacity of generating station, for a .5 load factor.	Total kilowatts rated capacity of generating sets excluding exciters and sets for lighting and power in generating station.	Average load based on a 24-hour day.	Maximum load (based on .5 load factor).
Dublin	13	3600	1480	2960
C.L.R.	19.5	5100	2220	4400
Glasgow	44	11200	5000	10000
Neasden	58	14000	6600	13200
Chelsea	200	44000	22800	45600

TABLE I.

Class.	Millions of kw-hours delivered from generating station per yr.	Condensing or non-condensing.	British station (B) or Abroad (A).	Accumulators employed or not in generating station.	Kw-hours delivered by accumulators during year.	Kw-hours by accumulators in per cent. of total kw.-hours.	Steam superheated or not.	Average amount of superheat in deg. Cent.	Quality of coal used.	Calorific value in kw-hours per ton.	No. of tons of coal burned per year.	Price in shillings per ton.	Use to which the electrical energy is put. Light, L.; Traction, T.; Power, P.	Average load factor of generating station per year.	Date of end of year for which data applies.	Year of working.	(C) Total kw-hours of calorific value of coal burned per year.	(D) Total output in kw-hours during year.	$\frac{100\ D}{C}$ Efficiency of generating station in per cent.
Bet. 0.9 and 3.3 millions of kw-hours per year.	0.95	Not stated	A	Accumulators Employed	177,600	18.7	Not stated	Not stated	German bituminous	8,600	2,080	21.4	L.P.T.	18.8	1904	6th	17,900,000	948,000	5.3
	0.97	Not stated	A	Accumulators Employed	148,880	15.4	Not stated	Not stated	German bituminous	8,500	2,730	9.6	L.P.T.	27.5	1903-1904	4th	23,200,000	965,000	4.16
	1.00	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	9,000	3,100	11.0	L.T.	15.4	March, 1904.	6th	27,900,000	1,000,000	3.58
	1.09	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	7,700	4,250	11.5	L.	16.0	March 25, 1904	7th	32,700,000	1,090,000	3.34
	1.18	Not stated	A	Accumulators Employed	200,300	17.0	Not stated	Not stated	Westphalian anthracite	8,150	3,458	18.0	L.P.T.	14.05	1903-1904	5th	28,200,000	1,177,000	4.2
	1.33	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	28°	Small peas	9,100	8,200	7.7	T.	13.8	March, 1903.	10th	74,500,000	1,330,000	1.79
	2.07	Not stated	A	Accumulators Employed	262,738	12.7	Not stated	Not stated	Westphalian bituminous	9,050	4,190	14.2	L.P.T.	43.6	1903-1904	5th	37,900,000	2,070,000	5.5
	2.25	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Portion slightly superheated	Best Welsh Derby pea nuts	8,500	17,300	10.75	T.	11.6	March 31, 1904.	6th	147,000,000	2,250,000	1.52
	2.90	Condensing	B	Accumulators Employed	Not stated	Not stated	None	Not stated	Derby pea nuts	9,500	11,300	12.3	L.	12.1	March 31, 1903	10th	107,300,000	2,900,000	2.7
	3.02	Not stated	A	Accumulators Employed	211,000	7.0	Not stated	Not stated	Yorkshire steam	8,320	5,940	12.6	L.P.T.	20.5	1903-1904	12th	49,400,000	3,020,000	6.1
	3.12	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Very little superheat	Not stated Fife small	7,100	10,800	8.2	T.	17.4	March 15, 1904	Not stated	76,600,000	3,120,000	4.06
	3.25	Not stated	A	Accumulators Employed	180,000	5.6	Not stated	Not stated	Scotch anthracite and German anthracite	7,100	7,500	16.3	L.P.T.	13.7	1903-1904	14th	53,200,000	3,250,000	6.1
Bet. 6 and 13 millions of kw hours per year.	6.3	Not stated	A	No accumulators employed	Not stated	Not stated	Not stated	Not stated	German lignite	5,600	22,580	10.1	L.P.	35.0	1904	11th	126,300,000	6,260,000	4.95
	8.2	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	8,020	16,500	9.75	T.	Not stated	....	Not stated	132,500,000	8,200,000	6.2
	9.0	Not stated	A	Accumulators Employed	Not stated	Not stated	Superheated	Not stated	German lignite	2,800	44,900	Not stated	T.	76.7	1904	9th	126,000,000	8,988,000	7.14
	9.4	Condensing	B	Not stated	Not stated	Not stated	Superheated	Part superheated to 238°	Smudge	7,060	26,100	5.0	L.P.	14.5	March 25, 1905	Not stated	184,000,000	9,400,000	5.1
	9.5	Condensing	B	Not stated	Not stated	Not stated	None	Not stated	Slack	7,700	20,300	8.2	T.	Not stated	March 25, 1904	11th	156,500,000	9,500,000	6.05
	10.1	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	28° to 56°	Slack	9,320	18,000	7.7	L.P.T.	28.6	March 31, 1905	Not stated	168,000,000	10,100,000	6.10
	11.9	Not stated	A	Accumulators Employed	Not stated	Not stated	Not stated	Not stated	Lignite briquettes and gas coke	8,350	20,800	13.0	L.P.T.	38.1	1904	13th	173,500,000	11,890,000	6.85
	12.5	Not stated	A	Accumulators Employed	Not stated	Not stated	Not stated	Not stated	Cardiff and Westphalian	8,750	19,800	Not stated	L.P.T.	40.1	1904	10th	173,000,000	12,480,000	7.21
Bet. 18 and 45 millions of kw-hours per year.	18.1	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	9,300	30,184	16.45	T.	Not stated	April, 1905.	Not stated	290,000,000	18,100,000	6.45
	23.0	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Superheated to 260°	Washed nuts	8,100	35,270	6.4	T.	30.8	May 31, 1905	5th	286,000,000	23,000,000	8.06
	26.7	Not stated	A	Accumulators Employed	2,491,000	9.4	Not stated	Not stated	Westphalian bituminous	8,750	40,800	17.1	L.P.T.	34.3	1903-1904	3rd-16th	357,000,000	26,650,000	7.46
	29.6	Not stated	A	Accumulators Employed	275,000	0.93	Not stated	Not stated	Cardiff	8,750	43,800	Not stated	L.P.T.	Not stated	1904	5th	383,000,000	29,600,000	7.75
	41.5	Not stated	A	Accumulators Employed	1,188,000	2.86	Not stated	Not stated	German lignite	7,750	56,000	Not stated	L.P.T.	35.2	1904	3d	433,000,000	41,500,000	9.61
	45.0	Both	B	Accumulators Employed	Not stated	Not stated	Superheated	Part superheated to 50°	Washed slack	8,940	75,000	10 0	L.P.T.	25.5	March 31, 1905	Not stated	670,000,000	45,000,000	6.72

TABLE VII.

Temperature of saturated steam.	⟨Consult These Columns to Obtain the Energy in Kilowatt Hours⟩ Contained in One Ton of Steam. (Component parts, i. e., Increase in Energy when Heating one Ton of)				⟨Consult These Columns to Obtain the Energy in Kilowatt Hours⟩ Necessary to Raise One Ton of Steam at Constant Pressure. (Component Parts, i. e., Heat Required to Raise One Ton of)				⟨Specific volume in cubic meters per Kg. (Total Energy, i. e., Heat Required to Raise Steam from One Ton of Water at 0° C.)⟩				Specific weight in Kgs. per cubic meter.			
	Absolute pressure in kgs. per sq. cm.	Temperature in centigrade scale (t)	Absolute temperature (= 273 + t).	Water at 0° C. to water at t° C. (heat in liquid)	Water at t° C. to saturated steam at t° C.	Saturated steam to steam at 50° C. superheat.	Steam from 50° C. superheat to 100° C. superheat.	Steam from 100° C. superheat to 150° C. superheat.	Saturated steam to steam at 50° C. superheat.	Steam at 50° C. superheat.	Steam at 100° C. superheat.	Steam at 150° C. superheat.	Saturated steam.	Steam at 50° C. superheat.	Steam at 100° C. superheat.	Steam at 150° C. superheat.
	Col. 1.	Col. 2.	Col. 3.	Col. 4.	Col. 5.	Col. 6.	Col. 7.	Col. 8.	Col. 9.	Col. 10.	Col. 11.	Col. 12.	Col. 13.	Col. 14.	Col. 15.	Col. 16.	Col. 17.	Col. 18.	Col. 19.	Col. 20.	Col. 21.	Col. 22.	Col. 23.	Col. 24.	Col. 25.	Col. 26.	Col. 27.	Col. 28.	Col. 29.
	.05	32	305	32.1	639	31.2	31.2	31.2	677	698	719	740	31.2	677	27.6	27.6	27.6	717	27.6	745	801	28.0	33.4	38.2	42.8	35.7	.03	.0262	.0234
	.06	36	309	41.9	636	31.2	31.2	31.2	678	699	720	741	31.2	677	27.6	27.6	27.6	718	27.6	745	803	28.0	34.1	38.2	43.4	35.6	.0356	.0312	.0277
	.07	39	312	45.4	633	31.2	31.2	31.2	680	700	721	742	31.2	678	27.6	27.6	27.6	719	27.6	746	804	28.0	34.1	38.2	43.5	35.7	.0415	.0362	.0317
	.08	42	315	46.9	631	31.2	31.2	31.2	681	701	722	743	31.2	679	27.6	27.6	27.6	719	27.6	746	805	28.0	34.1	38.2	43.5	35.8	.0468	.0409	.0365
	.09	44	317	51.3	629	31.3	31.3	31.3	682	701	722	743	51.3	679	27.6	27.7	27.7	719	27.6	746	805	28.0	34.1	38.2	43.5	35.8	.0516	.0453	.0408
	.1	46	319	53.6	627	31.3	31.3	31.3	682	701	722	743	53.6	679	27.7	27.7	27.7	719	27.6	746	805	28.0	34.1	38.2	43.5	35.8	.0564	.0493	.0447
	.12	49	324	57.0	626	31.4	31.3	31.3	683	704	725	746	57.0	680	27.7	27.7	27.7	722	27.7	750	808	28.0	34.2	38.3	43.6	35.9	.0686	.0595	.0542
	.14	52	328	60.5	623	31.4	31.3	31.3	683	704	725	746	60.5	680	27.9	27.7	27.7	723	27.7	750	807	28.0	34.2	38.3	43.6	35.9	.0813	.0709	.0643
	.16	55	332	63.8	621	31.5	31.4	31.4	684	705	726	747	63.8	681	27.9	27.8	27.8	724	27.8	752	808	28.0	34.2	38.3	43.6	35.9	.0902	.0795	.0708
	.18	58	335	67.0	619	31.5	31.4	31.4	685	706	727	748	67.0	682	27.9	27.8	27.8	725	27.8	753	809	28.0	34.2	38.3	43.6	35.9	.1005	.0885	.0789
	.2	60	338	69.8	617	31.5	31.5	31.5	685	707	728	749	69.8	683	28.0	27.9	27.9	726	27.9	754	811	28.1	34.3	38.4	43.7	36.0	.1113	.0985	.0877
	.22	63	342	73.4	615	31.5	31.5	31.5	686	707	728	749	73.4	684	28.1	28.0	28.0	727	28.0	755	812	28.1	34.3	38.4	43.7	36.0	.1215	.1085	.0965
	.24	66	345	76.8	613	31.5	31.5	31.5	686	708	729	750	76.8	685	28.2	28.1	28.1	728	28.1	756	813	28.2	34.4	38.5	43.8	36.1	.1317	.1186	.1054
	.26	69	348	80.4	611	31.6	31.5	31.5	687	708	729	750	80.4	686	28.3	28.2	28.2	729	28.2	757	813	28.3	34.4	38.5	43.8	36.1	.1420	.1286	.1144
	.28	72	351	83.8	609	31.6	31.6	31.6	688	709	730	751	83.8	687	28.4	28.3	28.3	730	28.3	758	814	28.4	34.5	38.6	43.9	36.2	.1523	.1386	.1235
	.3	75	354	87.3	607	31.6	31.6	31.6	689	711	732	753	87.3	688	28.5	28.4	28.4	731	28.4	759	815	28.5	34.6	38.7	44.0	36.3	.1627	.1486	.1326
	.35	78	358	90.8	604	31.7	31.6	31.6	689	711	733	755	90.8	689	28.6	28.5	28.5	732	28.5	760	816	28.6	34.7	38.8	44.1	36.4	.1730	.1586	.1417
	.4	81	361	94.4	601	31.8	31.7	31.7	690	712	733	755	94.4	690	28.7	28.6	28.6	733	28.6	761	817	28.7	34.8	38.9	44.2	36.5	.1833	.1686	.1508
	.45	87	368	99.8	599	31.8	31.8	31.8	690	712	734	756	99.8	691	28.8	28.7	28.7	734	28.7	762	818	28.8	34.9	39.0	44.3	36.6	.1936	.1786	.1599
	.5	90	373	103.0	595	31.8	31.8	31.8	691	713	735	757	103.0	693	28.9	28.8	28.8	735	28.8	763	819	28.9	35.0	39.1	44.4	36.7	.2040	.1886	.1690
	.55	93	377	106.0	592	31.8	31.8	31.8	692	714	735	757	106.0	693	28.9	28.8	28.8	736	28.8	764	820	28.9	35.0	39.1	44.4	36.7	.2143	.1986	.1781
	.6	96	380	109.0	589	31.9	31.8	31.8	693	715	736	758	109.0	694	29.0	28.9	28.9	737	28.9	765	821	29.0	35.1	39.2	44.5	36.8	.2246	.2086	.1872
	.65	99	384	112.0	586	31.9	31.9	31.9	694	716	737	759	112.0	695	29.0	28.9	28.9	738	28.9	766	822	29.1	35.2	39.3	44.6	36.9	.2350	.2186	.1963
	.7	102	387	115.0	583	31.9	31.9	31.9	695	717	738	760	115.0	696	29.1	29.0	29.0	739	29.0	767	823	29.2	35.3	39.4	44.7	37.0	.2453	.2286	.2054
	.75	105	391	118.0	581	32.0	31.9	31.9	696	718	739	761	118.0	697	29.2	29.1	29.1	740	29.1	768	824	29.3	35.4	39.5	44.8	37.1	.2557	.2386	.2145
	.8	107	394	121.0	579	32.0	32.0	32.0	697	719	740	762	121.0	698	29.3	29.2	29.2	741	29.2	769	825	29.4	35.5	39.6	44.9	37.2	.2660	.2486	.2236
	.85	110	397	123.9	577	32.1	32.0	32.0	698	720	741	763	123.9	699	29.4	29.3	29.3	742	29.3	770	826	29.5	35.6	39.7	45.0	37.3	.2763	.2586	.2327
	.9	113	400	126.9	575	32.1	32.1	32.1	699	721	742	764	126.9	700	29.5	29.4	29.4	743	29.4	771	827	29.6	35.7	39.8	45.1	37.4	.2866	.2686	.2418
	.95	116	403	129.8	573	32.2	32.1	32.1	700	722	743	765	129.8	701	29.6	29.5	29.5	744	29.5	772	828	29.7	35.8	39.9	45.2	37.5	.2969	.2786	.2509
	1.0	118	406	132.8	571	32.2	32.2	32.2	701	723	744	766	132.8	702	29.7	29.6	29.6	745	29.6	773	829	29.8	35.9	40.0	45.3	37.6	.3072	.2886	.2600
	1.05	121	409	135.7	569	32.3	32.2	32.2	702	724	745	767	135.7	703	29.8	29.7	29.7	746	29.7	774	830	29.9	36.0	40.1	45.4	37.7	.3175	.2986	.2691
	1.1	123	412	138.6	567	32.3	32.3	32.3	703	725	746	768	138.6	704	29.9	29.8	29.8	747	29.8	775	831	30.0	36.1	40.2	45.5	37.8	.3278	.3086	.2782
	1.15	126	415	141.5	565	32.4	32.3	32.3	704	726	747	769	141.5	705	30.0	29.9	29.9	748	29.9	776	832	30.1	36.2	40.3	45.6	37.9	.3381	.3186	.2873
	1.2	128	418	144.4	563	32.4	32.4	32.4	705	727	748	770	144.4	706	30.1	30.0	30.0	749	30.0	777	833	30.2	36.3	40.4	45.7	38.0	.3484	.3286	.2964
	1.25	131	421	147.3	561	32.5	32.4	32.4	706	728	749	771	147.3	707	30.2	30.1	30.1	750	30.1	778	834	30.3	36.4	40.5	45.8	38.1	.3587	.3386	.3055
	1.3	133	424	150.2	559	32.5	32.5	32.5	707	729	750	772	150.2	708	30.3	30.2	30.2	751	30.2	779	835	30.4	36.5	40.6	45.9	38.2	.3690	.3486	.3146
	1.35	136	427	153.1	557	32.6	32.5	32.5	708	730	751	773	153.1	709	30.4	30.3	30.3	752	30.3	780	836	30.5	36.6	40.7	46.0	38.3	.3793	.3586	.3237
	1.4	139	430	156.0	555	32.6	32.6	32.6	709	731	752	774	156.0	710	30.5	30.4	30.4	753	30.4	781	837	30.6	36.7	40.8	46.1	38.4	.3896	.3686	.3328
	1.45	141	433	158.9	553	32.7	32.6	32.6	710	732	753	775	158.9	711	30.6	30.5	30.5	754	30.5	782	838	30.7	36.8	40.9	46.2	38.5	.3999	.3786	.3419
	1.5	144	436	161.8	551	32.7	32.7	32.7	711	733	754	776	161.8	712	30.7	30.6	30.6	755	30.6	783	839	30.8	36.9	41.0	46.3	38.6	.4102	.3886	.3510
	1.55	147	439	164.7	549	32.8	32.7	32.7	712	734	755	777	164.7	713	30.8	30.7	30.7	756	30.7	784	840	30.9	37.0	41.1	46.4	38.7	.4205	.3986	.3601
	1.6	149	442	167.6	547	32.8	32.8	32.8	713	735	756	778	167.6	714	30.9	30.8	30.8	757	30.8	785	841	31.0	37.1	41.2	46.5	38.8	.4308	.4086	.3692
	1.65	152	445	170.5	545	32.9	32.8	32.8	714	736	757	779	170.5	715	31.0	30.9	30.9	758	30.9	786	842	31.1	37.2	41.3	46.6	38.9	.4411	.4186	.3783
	1.7	154	448	173.4	544	32.9	32.9	32.9	715	737	758	780	173.4	716	31.1	31.0	31.0	759	31.0	787	843	31.2	37.3	41.4	46.7	38.9	.4514	.4286	.3874
	1.75	157	451	176.3	542	33.0	32.9	32.9	716	738	759	781	176.3	717	31.2	31.1	31.1	760	31.1	788	844	31.3	37.4	41.5	46.8	39.0	.4617	.4386	.3965
	1.8	159	454	179.2	540	33.0	33.0	33.0	717	739	760	782	179.2	718	31.3	31.2	31.2	761	31.2	789	845	31.4	37.5	41.6	46.9	39.1	.4720	.4486	.4056
	1.85	162	457	182.1	538	33.1	33.0	33.0	718	740	761	783	182.1	719	31.4	31.3	31.3	762	31.3	790	846	31.5	37.6	41.7	47.0	39.2	.4823	.4586	.4147
	1.9	164	460	185.0	536	33.1	33.1	33.1	719	741	762	784	185.0	720	31.5	31.4	31.4	763	31.4	791	847	31.6	37.7	41.8	47.1	39.3	.4926	.4686	.4238
	1.95	167	463	187.9	534	33.2	33.1	33.1	720	742	763	785	187.9	721	31.6	31.5	31.5	764	31.5	792	848	31.7	37.8	41.9	47.2	39.4	.5029	.4786	.4329
	2.0	169	466	190.8	532	33.2	33.2	33.2	721	743	764	786	190.8	722	31.7	31.6	31.6	765	31.6	793	849	31.8	37.9	42.0	47.3	39.5	.5132	.4886	.4420
	2.1	174	472	196.6	528	33.3	33.3	33.3	723	745	766	788	196.6	724	31.9	31.8	31.8	767	31.8	795	851	32.0	38.1	42.2	47.5	39.7	.5337	.5086	.4602
	2.2	179	478	202.4	524	33.4	33.4	33.4	725	747	768	790	202.4	726	32.1	32.0	32.0	769	32.0	797	853	32.2	38.3	42.4	47.7	39.9	.5542	.5286	.4784
	2.3	184	484	208.2	520	33.5	33.5	33.5	727	749	770	792	208.2	728	32.3	32.2	32.2	771	32.2	799	855	32.4	38.5	42.6	47.9	40.1	.5747	.5486	.4966
	2.4	189	490	214.0	516	33.6	33.6	33.6	729	751	772	794	214.0	730	32.5	32.4	32.4	773	32.4	801	857	32.6	38.7	42.8	48.1	40.3	.5952	.5686	.5148
	2.5	193	496	219.8	512	33.7	33.7	33.7	731	753	774	796	219.8	732	32.7	32.6	32.6	775	32.6	803	859	32.8	38.9	43.0	48.3	40.5	.6157	.5886	.5330
	2.6	198	502	225.6	508	33.8	33.8	33.8	733	755	776	798	225.6	734	32.9	32.8	32.8	777	32.8	805	861	33.0	39.1	43.2	48.5	40.7	.6362	.6086	.5512
	2.7	203	508	231.4	504	33.9	33.9	33.9	735	757	778	800	231.4	736	33.1	33.0	33.0	779	33.0	807	863	33.2	39.3	43.4	48.7	40.9	.6567	.6286	.5694
	2.8	208	514	237.2	500	34.0	34.0	34.0	737	759	780	802	237.2	738	33.3	33.2	33.2	781	33.2	809	865	33.4	39.5	43.6	48.9	41.1	.6772	.6486	.5876
	2.9	213	520	243.0	496	34.1	34.1	34.1	739	761	782	804	243.0	740	33.5	33.4	33.4	783	33.4	811	867	33.6	39.7	43.8	49.1	41.3	.6977	.6686	.6058
	3.0	218	526	248.8	492	34.2	34.2	34.2	741	763	784	806	248.8	742	33.7	33.6	33.6	785	33.6	813	869	33.8	39.9	44.0	49.3	41.5	.7182	.6886	.6240
	3.1	223	532	254.6	488	34.3	34.3	34.3	743	765	786	808	254.6	744	33.9	33.8	33.8	787	33.8	815	871	34.0	40.1	44.2	49.5	41.7	.7387	.7086	.6422
	3.2	228	538	260.4	484	34.4	34.4	34.4	745	767	788	810	260.4	746	34.1	34.0	34.0	789	34.0	817	873	34.2	40.3	44.4	49.7	41.9	.7592	.7286	.6604
	3.3	233	544	266.2	480	34.5	34.5	34.5	747	769	790	812	266.2	748	34.3	34.2	34.2	791	34.2	819	875	34.4	40.5	44.6	49.9	42.1	.7797	.7486	.6786
	3.4	238	550	272.0	476	34.6	34.6	34.6	749	771	792	814	272.0	750	34.5	34.4	34.4	793	34.4	821	877	34.6	40.7	44.8	50.1	42.3	.8002	.7686	.6968
	3.5	243	556	277.8	472	34.7	34.7	34.7	751	773	794	816	277.8	752	34.7	34.6	34.6	795	34.6	823	879	34.8	40.9	45.0	50.3	42.5	.8207	.7886	.7150
	3.6	248	562	283.6	468	34.8	34.8	34.8	753	775	796	818	283.6	754	34.9	34.8	34.8	797	34.8	825	881	35.0	41.1	45.2	50.5	42.7	.8412	.8086	.7332
	3.7	253	568	289.4	464	34.9	34.9	34.9	755	777	798	820	289.4	756	35.1	35.0	35.0	799	35.0	827	883	35.2	41.3	45.4	50.7	42.9	.8617	.8286	.7514
	3.8	258	574	295.2	460	35.0	35.0	35.0	757	779	800	822	295.2	758	35.3	35.2	35.2	801	35.2	829	885	35.4	41.5	45.6	50.9	43.1	.8822	.8486	.7696
	3.9	263	580	301.0	456	35.1	35.1	35.1	759	781	802	824	301.0	760	35.5	35.4	35.4	803	35.4	831	887	35.6	41.7	45.8	51.1	43.3	.9027	.8686	.7878
	4.0	268	586	306.8	452	35.2	35.2	35.2	761	783	804	826	306.8	762	35.7	35.6	35.6	805	35.6	833	889	35.8	41.9	46.0	51.3	43.5	.9232	.8886	.8060
	4.1	273	592	312.6	448	35.3	35.3	35.3	763	785	806	828	312.6	764	35.9	35.8	35.8	807	35.8	835	891	36.0	42.1	46.2	51.5	43.7	.9437	.9086	.8242
	4.2	278	598	318.4	444	35.4	35.4	35.4	765	787	808	830	318.4	766	36.1	36.0	36.0	809	36.0	837	893	36.2	42.3	46.4	51.7	43.9	.9642	.9286	.8424
	4.3	283	604	324.2	440	35.5	35.5	35.5	767	789	810	832	324.2	768	36.3	36.2	36.2	811	36.2	839	895	36.4	42.5	46.6	51.9	44.1	.9847	.9486	.8606
	4.4	288	610	330.0	436	35.6	35.6	35.6	769	791	812	834	330.0	770	36.5	36.4	36.4	813	36.4	841	897	36.6	42.7	46.8	52.1	44.3	1.005	.9686	.8788
	4.5	293	616	335.8	432	35.7	35.7	35.7	771	793	814	836	335.8	772	36.7	36.6	36.6	815	36.6	843	899	36.8	42.9	47.0	52.3	44.5	1.025	.9886	.8970
	4.6	298	622	341.6	428	35.8	35.8	35.8	773	795	816	838	341.6	774	36.9	36.8	36.8	817	36.8	845	901	37.0	43.1	47.2	52.5	44.7	1.045	1.009	.9152
	4.7	303	628	347.4	424	35.9	35.9	35.9	775	797	818	840	347.4	776	37.1	37.0	37.0	819	37.0	847	903	37.2	43.3	47.4	52.7	44.9	1.065	1.029	.9334
	4.8	308	634	353.2	420	36.0	36.0	36.0	777	799	820	842	353.2	778	37.3	37.2	37.2	821	37.2	849	905	37.4	43.5	47.6	52.9	45.1	1.085	1.049	.9516
	4.9	313	640	359.0	416	36.1	36.1	36.1	779	801	822	844	359.0	780	37.5	37.4	37.4	823	37.4	851	907	37.6	43.7	47.8	53.1	45.3	1.105	1.069	.9698
	5.0	318	646	364.8	412	36.2	36.2	36.2	781	803	824	846	364.8	782	37.7	37.6	37.6	825	37.6	853	909	37.8	43.9	48.0	53.3	45.5	1.125	1.089	.9880
	5.1	323	652	370.6	408	36.3	36.3	36.3	783	805	826	848	370.6	784	37.9	37.8	37.8	827	37.8	855	911	38.0	44.1	48.2	53.5	45.7	1.145	1.109	1.006
	5.2	328	658	376.4	404	36.4	36.4	36.4	785	807	828	850	376.4	786	38.1	38.0	38.0	829	38.0	857	913	38.2	44.3	48.4	53.7	45.9	1.165	1.129	1.024
	5.3	333	664	382.2	400	36.5	36.5	36.5	787	809	830	852	382.2	788	38.3	38.2	38.2	831	38.2	859	915	38.4	44.5	48.6	53.9	46.1	1.185	1.149	1.042
	5.4	338	670	388.0	396	36.6	36.6	36.6	789	811	832	854	388.0	790	38.5	38.4	38.4	833	38.4	861	917	38.6	44.7	48.8	54.1	46.3	1.205	1.169	1.060
	5.5	343	676	393.8	392	36.7	36.7	36.7	791	813	834	856	393.8	792	38.7	38.6	38.6	835	38.6	863	919	38.8	44.9	49.0	54.3	46.5	1.225	1.189	1.078
	5.6	348	682	399.6	388	36.8	36.8	36.8	793	815	836	858	399.6	794	38.9	38.8	38.8	837	38.8	865	921	39.0	45.1	49.2	54.5	46.7	1.245	1.209	1.096
	5.7	353	688	405.4	384	36.9	36.9	36.9	795	817	838	860	405.4	796	39.1	39.0	39.0	839	39.0	867	923	39.2	45.3	49.4	54.7	46.9	1.265	1.229	1.114
	5.8	358	694	411.2	380	37.0	37.0	37.0	797	819	840	862	411.2	798	39.3	39.2	39.2	841	39.2	869	925	39.4	45.5	49.6	54.9	47.1	1.285	1.249	1.132
	5.9	363	700	417.0	376	37.1	37.1	37.1	799	821	842	864	417.0	800	39.5	39.4	39.4	843	39.4	871	927	39.6	45.7	49.8	55.1	47.3	1.305	1.269	1.150
	6.0	368	706	422.8	372	37.2	37.2	37.2	801	823	844	866	422.8	802	39.7	39.6	39.6	845	39.6	873	929	39.8	45.9	50.0	55.3	47.5	1.325	1.289	1.168
	6.1	373	712	428.6	368	37.3	37.3	37.3	803	825	846	868	428.6	804	39.9	39.8	39.8	847	39.8	875	931	40.0	46.1	50.2	55.5	47.7	1.345	1.309	1.186
	6.2	378	718	434.4	364	37.4	37.4	37.4	805	827	848	870	434.4	806	40.1	40.0	40.0	849	40.0	877	933	40.2	46.3	50.4	55.7	47.9	1.365	1.329	1.204
	6.3	383	724	440.2	360	37.5	37.5	37.5	807	829	850	872	440.2	808	40.3	40.2	40.2	851	40.2	879	935	40.4	46.5	50.6	55.9	48.1	1.385	1.349	1.222
	6.4	388	730	446.0	356	37.6	37.6	37.6	809	831	852	874	446.0	810	40.5	40.4	40.4	853	40.4	881	937	40.6	46.7	50.8	56.1	48.3	1.405	1.369	1.240
	6.5	393	736	451.8	352	37.7	37.7	37.7	811	833	854	876	451.8	812	40.7	40.6	40.6	855	40.6	883	939	40.8	46.9	51.0	56.3	48.5	1.425	1.389	1.258
	6.6	398	742	457.6	348	37.8	37.8	37.8	813	835	856	878	457.6	814	40.9	40.8	40.8	857	40.8	885	941	41.0	47.1	51.2	56.5	48.7	1.445	1.409	1.276
	6.7	403	748	463.4	344	37.9	37.9	37.9	815	837	858	880	463.4	816	41.1	41.0	41.0	859	41.0	887	943	41.2	47.3	51.4	56.7	48.9	1.465	1.429	1.294
	6.8	408	754	469.2	340	38.0	38.0	38.0	817	839	860	882	469.2	818	41.3	41.2	41.2	861	41.2	889	945	41.4	47.5	51.6	56.9	49.1	1.485	1.449	1.312
	6.9	413	760	475.0	336	38.1	38.1	38.1	819	841	862	884	475.0	820	41.5	41.4	41.4	863	41.4	891	947	41.6	47.7	51.8	57.1	49.3	1.505	1.469	1.330
	7.0	418	766	480.8	332	38.2	38.2	38.2	821	843	864	886	480.8	822	41.7	41.6	41.6

from these two stations, neither of which are as yet in full running order.

Single generating stations may thus deliver hundreds of millions of kilowatt-hours of electrical energy per annum. Let us roughly block out some preliminary figures for stations of capacities for delivering 10, 30, 90 and 270 millions of kw-hours per annum. By reference to Table IV it is seen that while for the smaller of these stations it will be necessary to install generating sets having 280 kw rated capacity per million kw-hours per annum, the largest station will require but 200 kw rated capacity per million kw-hours per annum. The total rated capacity of generating sets to be installed, the number of sets and the rated capacity per set, are indicated in Table V.

TABLE V.

Millions of kw-hours per annum.	Rated capacity of generating sets per million kw-hours per annum, for .5 load factor.	Total rated capacity of generating sets to be installed.	No. of generating sets to be installed.	Rated capacity of each generating set.
10	280	2800	4	700
30	240	7200	4	1800
90	210	18900	4	4700
270	200	54000	8	6800

With steam generating sets practically as low a rate of steam consumption has been obtained with 1,800-kw sets as with any of larger capacity. Hence, for all but the smallest station estimates can be based on the same average steam consumption. Taking an absolute admission pressure of 13 kg. per sq. cm. (185 lbs. per sq. in.), 50° C. (90° F.) of superheat, and a vacuum of 86.6 per cent (26 in.), a fair figure for the "all-day" steam consumption of the 700-kw sets will be 9.2 kg. (20.2 lbs.) per kw-hour, and for the larger sets 8.5 kg. (18.7 lbs.) per kw-hour.

The next steps in the estimate are set forth in Table VI.

TABLE VI.

Capacity in millions of kw-hours per annum.	Steam Consumption in kgs. per kw-hour.	Tons of steam consumed per annum.	Average tons of steam per hour during year.
10	9.2	92,000	10.5
30	8.5	255,000	29.2
90	8.5	765,000	87.5
270	8.5	2,300,000	262

The next step is to work back from the steam to the coal. Table VII, page 903, shows the properties of steam in terms used in electrical engineering. From this table it is seen that for the assumed standard conditions of pressure and superheat one ton of steam contains 812 kw-hours more energy than is contained in water at 0° C. (32° F.). The temperature of the feed water, however, may be taken as 50° C. (90° F.) since the condensation will be re-employed.

From column 4 of Table VII it is ascertained that 58.1 kw-hours are required to raise one ton of water from 0° C. to 50° C. Hence to obtain one ton of steam at the standard conditions of pressure and superheat, from feed water at 500° C., it will be necessary to impart to the steam 812 kw-hours — 58 kw-hours = 754 kw-hours.

Now the average boiler efficiency will be to a considerable extent dependent upon the size of the station, because the larger the station, the [illegible] the percentage of the boilers in operation at other than full-load conditions. Hence, for the four plants the average boiler efficiency for the year may be taken at 65, 68, 70 and 71 per cent, respectively. Taking 5 per cent loss in the steam piping for all cases the combined efficiency of boilers and steam piping will be 62, 65, 67 and 68 per cent, respectively.

Thus there must be burned under the boiler a fuel of such quality and amount as to provide during the year the energy of combustion shown in the last two columns of Table VIII.

TABLE VIII.

Capacity in millions of kw-hours per annum.	Tons of steam consumed by generating sets per annum.	Energy to be given to each ton of steam in kw-hours.	Total energy to be imparted to steam per year, in millions of kw-hours.	Efficiency of boilers and steam piping, in per cent.	Total energy of combustion in millions of kw-hours per annum.	Total energy of combustion per hour during year, in kw-hours.
10	92,000	754	69.4	62	112	12,800
30	255,000	754	192	65	296	33,800
90	765,000	754	576	67	860	98,000
270	2,300,000	754	1730	68	2550	292,000

From the data in Table VIII may be obtained the annual overall efficiency of these generating stations, as shown in Table IX.

TABLE IX.

Capacity in millions of kw-hours delivered from station per annum (S).	Total energy of combustion of coal burned in millions of kw-hours per annum (T).	Annual overall efficiency of generating station $\left(\frac{100\ S}{T}\right)$ in per cent.
10	112	8.9
30	296	10.1
90	860	10.5
270	2550	10.6

From the curves in Fig. 1 it is seen that the best annual overall efficiencies obtained in practice, on plants of 10 and 30 millions of kw-hours annual capacity, are 6.7 and 8.2 per cent, respectively, as against the above-estimated figures of 8.8 and 10.1 per cent.

As the assumptions in developing the estimates for these four stations have been very conservative, it may be said that it would be reasonable to attempt to improve best present practice as indicated by the upper curve in Fig. 1, by at least 33 per cent in stations of 10 million kw-hours annual output, and by some 23 per cent in stations of 30 millions of kw-hours of annual output, as seen from the following equations:

$$\frac{8.9}{6.7} = 1.33 \qquad \frac{10.1}{8.2} = 1.23$$

The results for the annual overall efficiency as arrived at in the last column of Table IX are plotted in Fig. 2.

Returning to the estimates, let us assume that there is used a quality of coal having a calorific value of 8,700 kw-hours per ton.

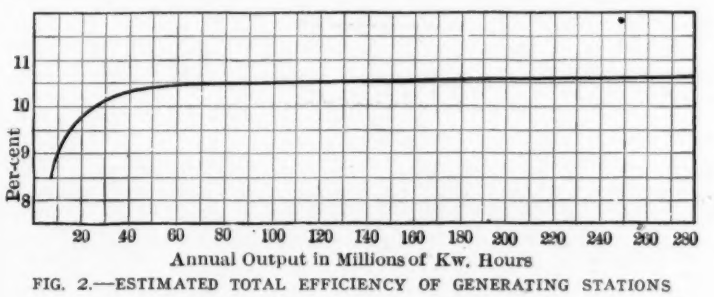


FIG. 2.—ESTIMATED TOTAL EFFICIENCY OF GENERATING STATIONS FROM COAL PILE TO OUTGOING CABLES.

From this figure there is obtained at once the number of tons of coal burned per year, as set forth in Table X.

TABLE X.

Capacity in millions of kw-hours per annum.	Total energy of combustion per annum in millions of kw-hours.	Energy of combustion of one ton of coal.	Tons of coal consumed per year.	Tons of coal consumed per hour (average for year).
10	112	8700	12900	1.47
30	296	8700	34000	3.88
90	860	8700	99000	11.3
270	2550	8700	294000	33.6

In Table XI are derived results for the kilograms of coal burned (of a calorific value of 8,700 kw-hours per ton) per kw-hour of electrical energy delivered from the generating station per annum.

TABLE XI.

Capacity in millions of kw-hours delivered from generating station per annum.	Kg. of coal burned per annum.	Kg. of coal per kw-hours delivered.
10	12,900,000	1.29
30	34,000,000	1.13
90	99,000,000	1.10
270	294,000,000	1.09

Following these rough preliminary estimates of the quantities involved, the design and arrangement of coal bunkers, coal conveyors, boilers, superheaters, condensing plant, piping, generating sets, cables and switchboards, all require detailed consideration. Into these questions it is not proposed to enter, the purpose of the article having been to lay down a systematic plan of procedure in the design of plant of the type indicated, and to point out that it should be practicable to effect great improvement in the efficiency of most electrical generating stations.

The New Lighting Campaign in Topeka, Kan.

An active campaign for the increase of business has been begun by the Topeka Edison Company. For nine months previous to last July the work of extending this company's business was almost at a standstill on account of negotiations for a new franchise which were going on at that time. On July 14, 1905, the company was granted a franchise for 30 years. At this time new interests took hold, represented by L. E. Myers, of Chicago, and the name of the company was changed from the Edison Electric Illuminating Company to the Topeka Edison Company. The company had never extended its lines into some of the most important residence districts, so that as soon as the new franchise was granted an active campaign was begun not only to increase the business in the downtown districts of the Edison direct-current, three-wire network, but also to secure as much new business among residences on the alternating-current circuits as possible. Under the new franchise a reduction of 40 per cent from the old rate for residence lighting is made. This has been made the text of an active advertising campaign for new residence business.

One of the most effective means of advertising has been a form of portable electric sign, which is placed on one of the company's poles. These signs are changed in location every few days. They are usually placed in residence districts. The novelty of the electric sign in a neighborhood never fails to attract attention, and this is of course the first essential in advertising. These signs are made cylindrical in form to fit around a pole, being split and hinged in the middle so that they can be removed. The sign used at present has a row of lights at the top and bottom, with the reading matter on the face of the cylinder in between. The idea is rather to attract attention by the lights than to make the sign legible at any great distance.

Besides these portable signs a number of large electric signs have been placed on tops of buildings in the downtown district advertising the service. The wording of some of these signs is as follows: "Light up. The price is right." "A contract signed will increase your sales." "Your success depends on electric light." "Edison light means success. Use it." "Get ready. Xmas is coming. Edison light." "Put in Edison light for the holidays."

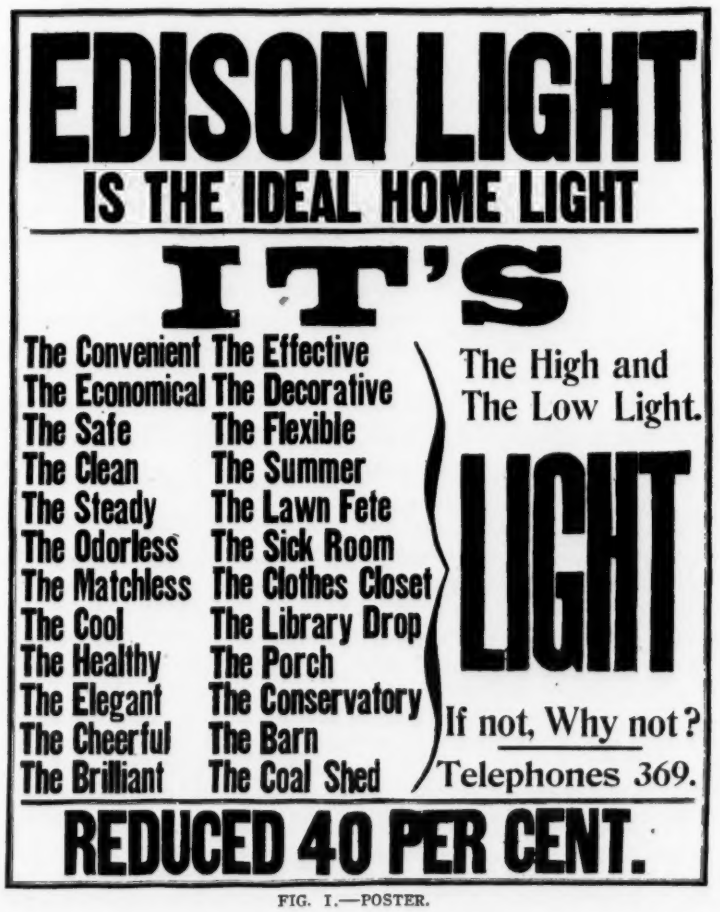


FIG. 1.—POSTER.

These are for signs in the business district. The portable signs in the residence district of course have matter appealing more directly to the householder, such as "Edison light will not explode," and other points brought out on some of the circular matter reproduced herewith.

A very effective poster, 18 by 24 in., has been printed in two colors and is reproduced in Fig. 1. A cheap form of poster has frequently been placed on the pole under a portable electric sign and it has been found that people stop to get copies of these. Four pages of a circular sent to residences are reproduced in Fig. 2, and two pages of another residence circular in Fig. 3.

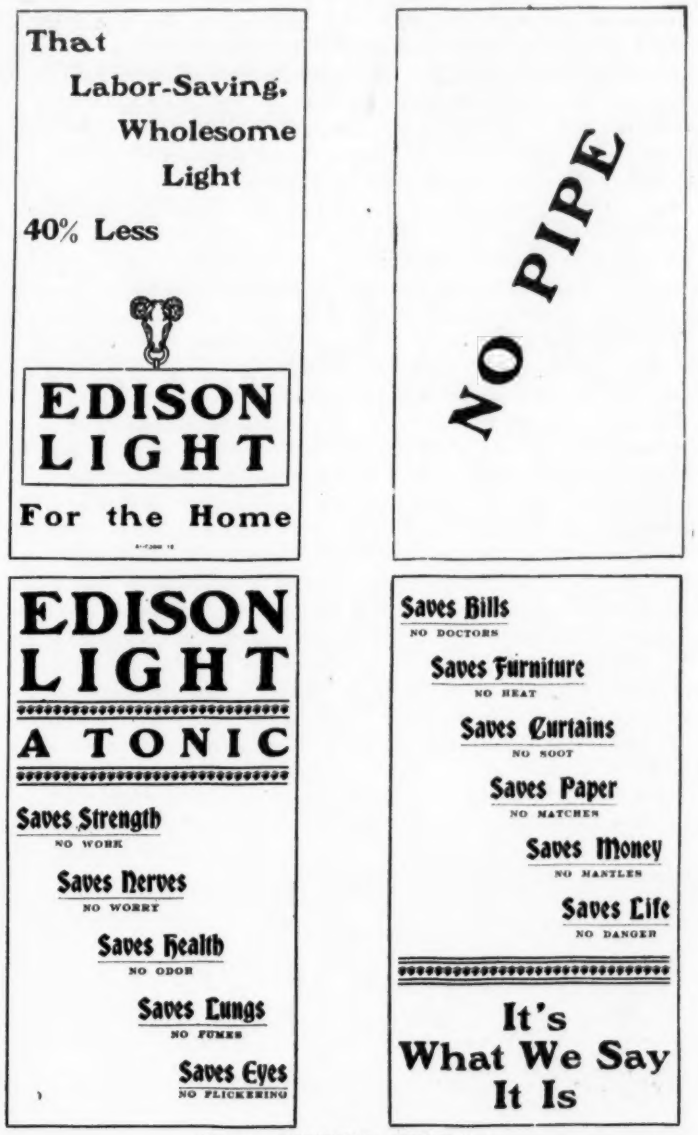


FIG. 2.—RESIDENCE CIRCULAR.

It will be seen from these that the Topeka management has the art of getting up very attractive advertising matter without great expense for costly designs. The advertising is very plain, direct and to the point. It is doubtless fully as effective as some upon which more money has been spent. The mistake has not been made of trying to crowd too much matter on a page. As gas competition has to be met, a "turn-down" incandescent lamp has been prominently advertised with circulars furnished by the manufacturer having the name of the Topeka Edison Company printed upon them. Another circular, the exact size of a cross-section of a 16-cp Edison lamp, is used, on one side of which is printed the outline of a lamp filament and base, the other side having matter worded somewhat like the poster in Fig. 1.

The new business campaign is being planned and carried out by Mr. C. R. Maunsell, general superintendent, and his brother, F. F. Maunsell, assistant general superintendent, the latter having direct charge of the work. Five solicitors are employed. Advertisements are placed in three of the principal Topeka newspapers, appearing three times each week in two papers and twice a week in one paper.

It has been the plan to concentrate attention in advertising and soliciting on one feature or class of business at one time and then take up another. The results of the first ten days' concentrated campaign in the business district resulted in the addition of 40

customers, which is certainly a remarkable record for a city the size of Topeka and shows what can be done by well-planned effort.

Fig. 4 shows the front and back of a card which advertises the rates for residence lighting in a manner easily understood, the power consumption of each common size of lamp being reduced to the basis of cost per hour. In the advertising intended for residence business it will be seen that the point most prominently brought out is the recent reduction in rate. It is human nature to be seeking bargains and as a reduction in rates is in the nature of a bargain not before obtainable, it is a strong point to advertise. Under the company's new franchise the same rates are open to all. While this equity in rates is required by the ordinance, it goes without saying that it is a desirable thing for the company, as it does away with any suspicion on the part of the public that there may be discriminations in favor of some customers. Under the old plan of not publishing rates, even though the same rate might be open to every man, those whose power consumption was of such a nature or quantity as to call for the higher rates would feel that some one else was getting a better rate. A public schedule of rates is a good thing for a company because of the confidence it gives. The rates under the several forms of contracts are as follows:

Residence lighting, 12 cents per kilowatt-hour. Commercial lighting, under a monthly contract, is 10 cents per kilowatt-hour, with a 10 per cent discount if the customer owns his arc lamps. The minimum bill for arc lighting is $2 per lamp per month. If the customer owns his arc lamps there is no such minimum.

Yearly contracts under the Wright demand system make a rate of 10 cents per kilowatt-hour for the first hour's use per day of the maximum demand; all in excess of that quantity is 6 cents per kilowatt-hour. Under this contract the minimum rates on arc lamps or equivalent connected load per month are as follows: First two arc lamps, $3 per month each; next three arc lamps, $2 per month each; all in excess of five arc lamps, 50 cents per month each. A 10 per cent discount is allowed if the customer owns all of the lamps and pays for all renewals.

Commercial lighting on the guarantee basis where the customer has ten or more incandescent lights or their equivalent is based on rates according to the following table, in which the first column indicates the guaranteed use per month:

Earnings.	Rates per 1,000 watt-hours.
25 cents.	8 cents.
30 "	7 "
45 "	6 "
60 "	5 "

The power rates are 8 cents per kilowatt-hour for electric elevators. For general motor work the rate is 6 cents per kilowatt-hour

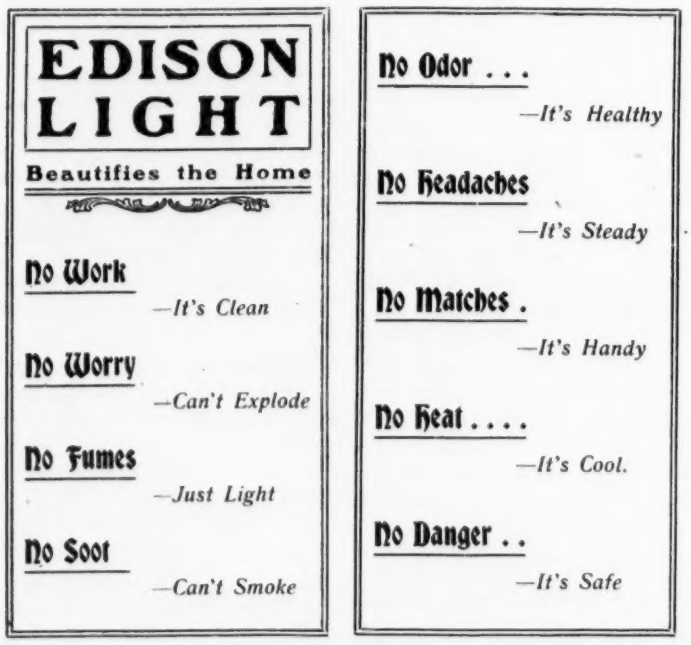

EDISON LIGHT
Beautifies the Home
No Work —It's Clean
No Worry —Can't Explode
No Fumes —Just Light
No Soot —Can't Smoke
No Odor . . . —It's Healthy
No Headaches —It's Steady
No Matches . —It's Handy
No Heat . . . . —It's Cool.
No Danger . . —It's Safe

FIG. 3.—RESIDENCE CIRCULAR.

for the first 1,000 kw-hours; five cents per kilowatt-hour for the second 1,000 kw-hours, and four cents per kilowatt-hour for the third 1,000 kw-hours. The minimum bill is $1 per connected horse-power up to and including 20 hp. Power up to 3 hp inclusive, where lights and motors are connected on the same meter will be charged at lighting rates. The minimum bill from April 1 to October 1 is 75 cents per month and for the balance of the year $1.50 per month. The consumer has the option of selecting any one of these systems of rates.

The company furnishes steam heat in the business district of Topeka for a distance of three blocks from the station. It is making no effort to extend this business, however, because it is not desirable to increase the steam heat load beyond what can be supplied from the exhaust steam during the day, and more customers want service than can obtain it.

Electric Light for Residence Use.

40 PER CENT CHEAPER THAN LAST YEAR

Minimum Bill for 6 Summer Months, 75c per month.

Minimum Bill for 6 Winter Months, $1.50 per month.

An electric light bears the same relation to a room that a smile does to a human being.

TOPEKA EDISON CO.

TELEPHONES 369. 722 VAN BUREN STREET.

(OVER)

RESIDENCE LIGHTING. SEPT. 1ST, 1905.

RATE, 12 CENTS PER 1000 WATT HOURS.			APPROXIMATE COST PER HOUR.
One 6 C. P. Lamp consumes	25	watts per hour,	.3 of one cent.
One 10 C. P. "	36	"	.43 of one cent.
One 16 C. P. "	50	"	.6 of one cent.
One 24 C. P. "	75	"	.9 of one cent.
One 32 C. P. "	100	"	1.2 cents

The Company will run **SERVICE WIRES** from their lines to buildings, and furnish the meter free.

LAMP RENEWALS will be furnished free when burned out lamps are returned to office or exchange stations.

HYLO LAMPS turn up and down, from ½ to 8, and 1 to 16 candle; save expense when only dim light is needed.

MERIDIAN LAMPS. A new lamp that doubles the useful illumination without increasing expense—25 and 50 candle.

(OVER)

FIG. 4.—CARD SHOWING RATES FOR RESIDENCE LIGHTING.

From what has been said about the recently begun campaign for new business in Topeka, it must not be thought that the management has been idle in times past, as it is evident on the downtown streets that the Edison Company has not been giving gas arcs much of a chance, and there is only one isolated plant in Topeka, which is that used for heating and lighting the State Capitol Building.

The company has connected about 1,700 hp in motors, 650 direct-current multiple arc lamps and the equivalent of 40,000 16-cp incandescent lamps. Topeka is now a city of probably about 40,000 inhabitants.

Vaporization of Metals by High Frequency Discharges.

When an electric discharge from a battery of Leyden jars is sent through a wire placed between two glass plates an excessive amount of heat may be generated in the wire in an extremely short time, and this heat is often sufficient to vaporize the wire. The consequent increase in pressure blows the vapor out in all directions, and as it cools it is deposited in the form of finely divided metal with vacant spaces in between. The deposit near the path of the wire is so close that light is reflected from it as from a uniform surface, but a little further from the wire the deposit lies in lines at right angles to the direction of the wire with metal free spaces between. Some tests made under these conditions and recorded photographically are described by F. Braun in a recent issue of the *Annalen der Physik*. A battery of 20 Leyden jars giving a 6-mm. to 8-mm. spark was employed, and wires of tantalum, zinc, carbon, brass, platinum, silver, etc., were dealt with. In the case of an incandescent lamp filament, actual vaporization did not take place, but globules of melted carbon were readily distinguishable under the microscope. In the case of alloys, by suitably adjusting the strength of discharge the several component metals could be separated, the metal of lower melting point being deposited nearest to the path of the wire.

Reflectors, Shades and Globes.—I.

BY J. R. CRAVATH AND V. R. LANSINGH.

IN designing illumination it is usually important to consider not only the location of the lights but the candle-power given in various directions by each light. In other words, we must consider as a unit each source of light together with the reflector, globe or shade which accompanies it before arriving at any conclusions as to the illumination. In the majority of cases where the resultant efficiency is any object, it is desirable to have some means of directing the rays from the sources of light, so that the strongest light will fall where most wanted. Manifestly, it is of first importance in illuminating engineering to know what various

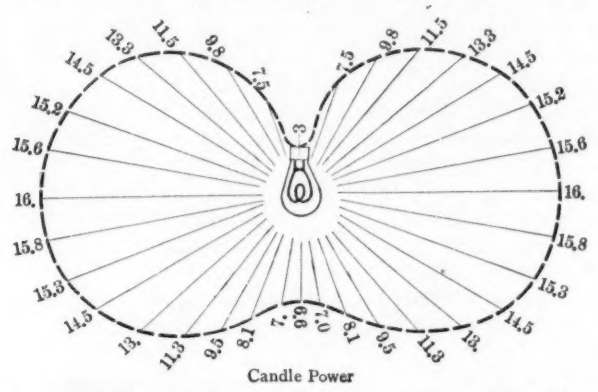


FIG. 1.—SHOWING DISTRIBUTION OF LIGHT ABOUT A BARE 16-CP INCANDESCENT LAMP WITH OVAL ANCHORED FILAMENT.

types of reflectors, shades and globes will accomplish in this respect. There has heretofore been but little generally available information on the photometric performance of common types of these. The tests given in this and following articles will help supply this need.

Reflectors, shades and globes are used for three purposes: (1) Softening and diffusing the light, (2) directing the rays of light in certain useful directions, (3) for ornament. A reflector, shade or globe may combine in one all these three characteristics or it may have only one of them. It is too often the case that the one chosen is not the right thing for the place or is chosen on its general appearance without any attempt to learn what it practically accomplishes in the way of altering the natural distribution of light from the lamp.

The reader can best be brought to realize the importance of a proper choice of reflectors and the great difference between reflectors, shades and globes by a study of tests made on lamps variously equipped showing the amount of light thrown in different directions above and below the lamp. All of the following diagrams were taken from photometric tests made by the Electrical Testing Laboratories of New York.

Fig. 1 shows the candle-power or intensity of the light thrown in different directions, in a vertical plane, from a bare 16-cp oval

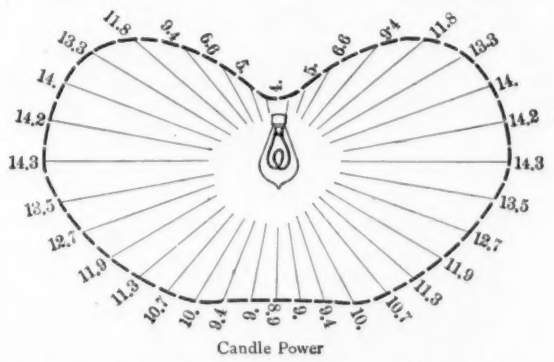


FIG. 2.—DISTRIBUTION OF LIGHT ABOUT A 16-CP INCANDESCENT LAMP FROSTED BY THE ACID ETCHING PROCESS.

anchored filament incandescent lamp with a clear glass bulb suspended vertically, as indicated in the diagram, and without any reflector or globe. It is seen that the lamp gives about 16 cp in a horizontal direction. In other directions the light is less. Directly below the lamp, the candle-power is 6.6. It is evident that a bare lamp like this, hung in a room, will show more light in the directions of the walls than anywhere else. Much will also go toward the ceiling. There are certain locations where this is desirable, most notably in small stores, where the shelves and goods hung on the show racks must be lighted as well as the counters. The same is true in warehouses and storage rooms.

Fig. 2 gives the light distribution about an incandescent lamp with a bulb, frosted by being etched with acid. This test was made after frosting the same lamp on which the test (Fig. 1) was made. By the term frosting is here meant the usual process of producing a rough surface in the glass itself by the use of acid, and not the coating or painting of the surface of the glass with white frosting. The latter process, known as dipping, is not satisfactory because unless a thick enough coat is applied to seriously cut down the light the glare from the bare filament is but imperfectly diffused. This test showed the absorption or loss of light due to frosting amounted to 11.5 per cent. Probably there is more loss than this in many cases. In Fig. 1 the mean spherical candle-power from the clear glass bulb incandescent lamp was 13.24. After frosting the bulb as in Fig. 2 the mean spherical candle-power was 11.71. The frosting of the bulb, it is seen, does not change the distribution of light about the lamp materially, but simply reduces the amount of light thrown in all directions except directly below the tip of the lamp, where the candle-power is increased from about 6.6 to 8.9. The loss of 11.5 per cent of the light by the frosting of the bulb is more than made up for in all locations where the lamps are placed within the line of ordinary vision; that is, when their rays fall directly in the eyes. The frosting of the glass diffuses the light so that it does not have the blinding effect that the bare incandescent filament has upon the eyes. Thus, although the actual amount of light may be reduced 11.5 per cent or more, one can really see better, and therefore the illumination is better with the frosted bulb lamps wherever the lamps are so located that the rays fall directly in the eye. For this reason it is desirable to use a frosted bulb in most locations where a bare incandescent lamp is to be used without reflectors or globes

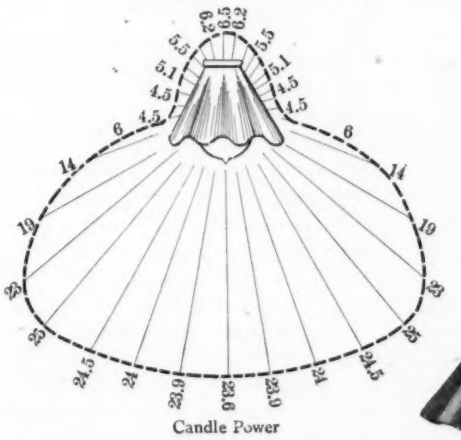


FIG. 3.—DISTRIBUTION OF LIGHT ABOUT A FLUTED OPAL CONE REFLECTOR.

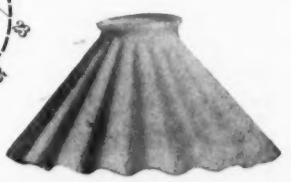


FIG. 3A.

of any kind. Thus, in a small store where it is desired to light the shelves as well as the counters, a lot of clear bulb incandescent lamps would seriously interfere with vision because of the blinding effect which has previously been explained. By using frosted bulbs this will be partially overcome. It is much easier to see beyond a frosted bulb lamp which is nearly in the line of vision than to see beyond a lamp with clear glass bulb. In some places where it is desirable to use frosted bulbs, there is so much dirt that their use is inadvisable because a rough frosted glass when it is once dirty is difficult to clean.

A point open to argument is whether, if a diffusing covering is wanted, it is better to use a frosted bulb lamp rather than a surrounding globe of frosted, ground or sand-blasted glass. The loss by absorption in the surrounding globe is likely to be greater than in the frosting on the glass of the lamp bulb. Tests are now in progress on the relative life of frosted bulb lamps compared to clear bulb lamps enclosed in globes, which will help throw light on this matter.

One thing decidedly in favor of frosted as against clear glass bulbs is their artistic appearance. The light from them is much more pleasing than from the clear bulb, which exposes the filament.

Frosted or sand-blasted glass so diffuses the light as to overcome the streaks which are quite pronounced with the clear glass bulb. These streaks are very objectionable where reading, writing, draught-

ing or any kind of close work is to be done. They cause a strain on the eyes which the user of the light is generally not aware of, and for that reason are specially to be avoided.

Where there is a mixture of daylight and artificial light, that from an incandescent lamp with a clear glass bulb lamp is likely to present a sickly, yellow appearance. This sickly appearance can be very much reduced, if not entirely eliminated, by the use of frosted or sand-blasted glass. This should be remembered in the lighting of stores, halls of hotels and office buildings, and all places where considerable light from incandescent lamps must be used during daylight hours in combination with daylight.

Fig. 3 gives the light distribution about a 16-cp incandescent lamp covered with what is commonly known to the trade as a fluted, opal cone reflector 6½ in. in diameter, the form of which is shown in Fig. 3A. This is one of the best and most efficient of the common, cheap types of reflector. It is useful wherever a large amount of light from the lamp is needed below the horizontal. It so changes the distribution of light about the incandescent lamp as to throw from 23 to 25 cp in all downward directions below 45° from the horizontal. The performance of opal reflectors of this kind depends somewhat upon the density of the opal glass used. The more dense the opal the greater the reflected light and the less that passing through the reflector. This particular reflector is fairly dense and hence lets comparatively little light escape above the horizontal. Enough, however, goes through the reflector to keep the walls and ceiling of a room from being in darkness. Such a reflector can properly be used in all cases where it is not objectionable from an artistic standpoint, and it is desirable to direct the light downward and at the same time allow a small amount of light to go to the walls and ceilings.

This opal cone reflector does not give anywhere near as great a maximum downward candle-power as some of the reflectors which will be shown later, but it illustrates very well what an enormous difference can be made in the amount of light thrown down from a lamp placed in a pendant position by the use of the proper reflector. Thus, for example, this reflector gives a candle-power directly below the lamp (that is, a tip candle-power) or 23.6, and at the angle of 40° from the vertical, a candle-power of 25. The bare lamp would give only 7 cp at the tip and less than 12 at the angle of 40° from the vertical. As lamps are so frequently placed high up in a room on chandeliers or pendants, or sometimes at the ceiling, the importance of directing the rays down so that they will be of use to the occupants of the room is apparent.

The ceilings and walls if light in color have considerable value as reflectors and diffusers. Where maximum efficiency is desired it must be remembered, however, that a reflector to be efficient must fit over a lamp and not be some distance from it, and that further much of the light is not reflected by walls and ceilings in the directions where it is desired, and must be reflected and re-reflected back and forth two or three times with much loss each time before it reaches the place that specially needs illumination.

In Fig. 4 is shown the light distribution about a 16-cp incandescent lamp equipped with a 5-in. opal bell reflector of the type shown in

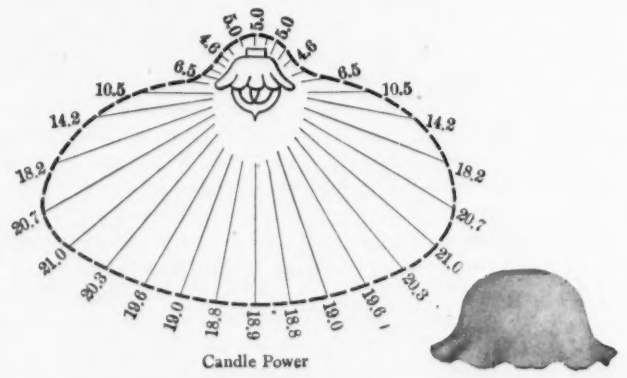


FIG. 4.—DISTRIBUTION OF LIGHT FROM 5-IN. OPAL REFLECTOR.

FIG. 4A.

Fig. 4A. This is a very common type of reflector and, as seen from Fig. 4, is excellent for securing general distribution of light in all downward directions where it is not desired to concentrate a great amount of light at any one point. As the lamp bulb projects a considerable distance out of this reflector, it is frequently necessary to use it with a frosted bulb lamp on account of the large amount of exposed filament. If such a reflector is to be used on an ordinary height of chandelier in small rooms, chandeliers should preferably be equipped with sockets pointing straight down or nearly so in order that an unnecessary amount of light be not thrown upward. Such a reflector put on a chandelier with lamp sockets at an angle of 45° will evidently throw much more light upward than is necessary unless there happen to be pictures or other objects high in a room which are to be illuminated.

Fig. 5 gives the light distribution about a 16-cp incandescent lamp with an 8-in. metal reflector painted white inside, the form of which is shown in Fig. 5A. This is the kind of reflector so often seen in workshops, draughting-rooms and offices. It is designed to concentrate considerable light below the lamp, and succeeds fairly well in

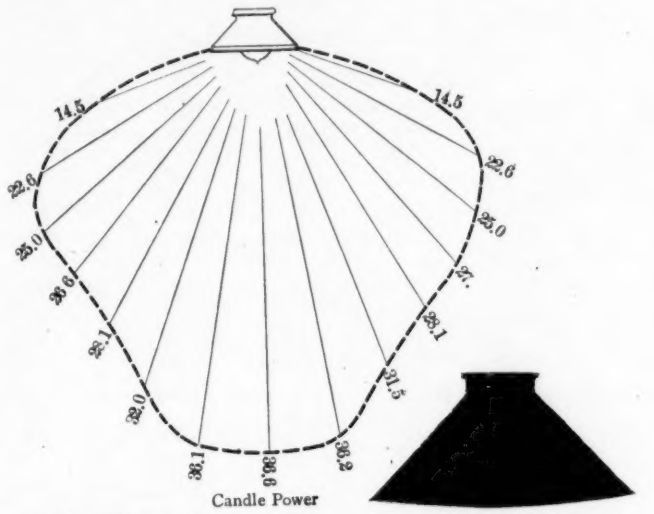


FIG. 5.—DISTRIBUTION OF LIGHT FROM AN 8-IN. METAL REFLECTOR.

FIG. 5A.

this, as can be seen. For a space 10° each side the vertical, it gives over 36 cp. Being of metal and entirely opaque, of course no light is thrown above the edges of the shade. The serious objection to such a shade as it stands is the extremely streaked light which it casts. In other words, it does not eliminate the streaks which are inherent in the incandescent lamp which is the source of light. Such a shade, if painted inside with aluminum paint, will give a well-diffused light practically free from streaks. Another way of getting over these streaks is to use a frosted bulb lamp. Although the authors have not secured tests on the relative efficiency of the reflector coated with white paint inside as against the reflector coated with aluminum paint, some rough, practical trials have convinced them that there is not enough difference between the white paint and the aluminum paint to be worth considering as far as the amount of light is concerned, while the quality of the light from the aluminum paint is vastly superior because of the freedom from streaks. These cheap metal reflectors are in very common use in draughting rooms and offices, where it is of greatest importance to the welfare of the users that they be not forced to strain their eyes with a streaked light of this kind. If the owners of such shades do not feel able to replace them with some of the more efficient types mentioned later, they can at least afford to have them coated inside with aluminum paint.

Further tests will be given in following articles.

Utilization of Victoria Falls.

The London *Times* announces that the question of utilizing the Victoria Falls for the generation of electrical power and its transmission to the Witwatersrand is receiving close attention at the hands of the African Concessions Syndicate. American and continental engineers are agreed that such a project could be made commercially successful, especially as the climate is most favorable to the scheme, being extremely dry, while there is no ice in the rivers to interfere with the working of the turbines, and no snow to break down the transmission lines. It is estimated that in the dryest season yet experienced 500,000 hp could have been developed. The available head of water is about 330 ft., but a head of 1,000 ft. could be obtained by engineering works of a comparatively light type. This head of water would produce 1,000,000 hp. At present $15,000,000 is spent annually on power on the Rand.

Pennsylvania Independent Telephone Association.

The second annual convention of the Pennsylvania Independent Telephone Association was held at the Monongahela House, Pittsburg, on November 9 and 10, over 200 delegates being in attendance from Pennsylvania, Ohio, Maryland and West Virginia.

At the first session a meeting of the executive committee was held at which various committees were appointed and the programme for the convention arranged. The afternoon session was called to order by second vice-president Charles Griffith, of Johnstown, who presided in the absence of President B. F. Meyers on account of illness. John A. Blair, assistant city solicitor, on behalf of the mayor, welcomed the delegates to Pittsburg and extended to them the courtesies of the city. The annual reports of officers were then submitted. In his report secretary Bradley stated that there are 50 organized operating independent telephone companies in Pennsylvania, all being allied with the association. There are in all 83 independent telephone companies in the State, but a considerable number of them are very small. The companies allied with the association operate 75,899 telephones, and 71,142 miles of toll circuits covering practically the entire State.

Mr. Charles West, of Allentown, general manager of the Consolidated Telephone Companies of Pennsylvania, spoke on the future of the independent telephone movement. He described how the independent movement started and suggested methods of strengthening the position of the independents. There was an interesting discussion at the conclusion of Mr. West's address. Several other addresses were also made during the afternoon session. The independent companies are taking an active part in the extension of lines among farmers. They encourage the farmers to build their own lines and then connect with some established company. By this method the farmer gets service for about $1.00 a month. Mr. West said that his companies send important news items to the farmers over the telephone. Four rings is the signal for everybody to get on the wire and the news is then transmitted to all the subscribers at the same time. The election returns were sent in this manner on the night of November 8.

Officers for the ensuing year were elected as follows: President, C. W. Kline, of Hazelton; first vice-president, Charles Griffith, of Johnstown; second vice-president, James Colins, of Philadelphia; secretary, H. E. Bradley, of Philadelphia; treasurer, C. E. Wilson. Executive committee: Edward Davis, of Philadelphia; Judge R. E. Umbel, of Uniontown; William B. Trask, of Erie; F. D. Houck, of Harrisburg; Charles West, of Allentown; E. D. Schade, of Johnstown; G. B. Ruby, of York, and J. G. Splane, of Pittsburg.

At the morning session of the second day resolutions of sympathy were adopted upon the death of W. D. Barnard, of Philadelphia, first vice-president of the Keystone Telephone Company, who died last September. A discussion dealing with the competition between the independent company and the Federal Telephone Company at Washington, Pa., was concluded, when Mr. C. E. Wilson offered a resolution, which was unanimously adopted, to the effect that the Federal Telephone Company is not an independent company, but is allied either directly or indirectly with the Bell Company.

A banquet was held in the evening, Senator J. S. Weller, vice-president and general counsel of the Pittsburg & Allegheny Telephone Company, acting as toastmaster. Speeches were made by a number of the officials of the various companies represented. The hall was neatly decorated for the occasion with palms, cut flowers and American flags, and covers were laid for 125 persons.

There was quite an extensive exhibit of telephone apparatus and materials which received the interested attention of the delegates. The Pittsburg & Allegheny Telephone Company entertained the delegates during the convention.

English Automobile Stage Lines

Up to the present time few interurban electric roads have been introduced in England, and by some authorities it is now thought that they will encounter sharp rivalry from proposed automobile stage lines. The automobile has already proved its utility in the linking up of villages and small towns which are either not served at all or indifferently served by the railways. It is also being largely adopted in providing direct cross-country services. Along the coasts of England there are hundreds of towns, many of them flourishing seaside resorts, which, while they are connected with inland districts, have no direct railway communication with each other. The motor 'bus is being utilized to supply this want.

One of the largest schemes provides for a service twice a day of motor 'buses along a hundred miles of coast road in North Wales, linking up en route five railway termini, five other stations, seven market towns, seven large villages where cattle fairs are regularly held, 12 coast ports, as well as numerous isolated villages. It is calculated that the annual revenue needed to cover all working expenses of the proposed service, provide for up-keep and depreciation, and pay 10 per cent on the ordinary shares will be secured if the earnings are at the rate of only 50 cents per head a year of a population of 80,000 residents within two miles of the route, and two cents per mile from parcels and luggage.

A double-deck type of car, to hold 34 passengers, has been adopted in London with few exceptions. Experiments were made with the single-deck 'bus, but it was a failure from the commercial point of view, as its carrying capacity was too small to enable the earnings to cover expenses. The success of the larger car is still in doubt, but the results so far justify the continuance of the conversion policy. The average expenditure is estimated to be about one-fifth greater than in the case of the horse-drawn 'bus, but the earning capacity of the motor 'bus is, at least, one-third greater.

In this connection it will be of interest to refer to the illustrated article published in our issue of Oct. 28 last, describing an electric stage, or omnibus, in use on Fifth Avenue, New York City. This vehicle is entirely self-contained, carrying a generator which is driven by a gasoline engine.

A Small Motor Testing Equipment.

BY ROY T. WELLS, PH.D.

IN much of the factory testing of small electric machines the test runs are short. Some are simply a loading of the machine to full load or overload for a few minutes, to observe the operating behavior as to sparking, etc.; others involve a heat run of a few hours loaded. These machines are frequently tested in the factory by fastening them to the floor and belting them to another machine, a driving motor or load generator according as the machine tested is to be operated as a generator or a motor. In a test of this sort a good deal of time is lost in placing the two machines so that the belt can be adjusted to run properly on the pulley. In a short test the time spent in placing the machines and in adjusting the belt may be a considerable fraction of the time used in the test.

In order to save much of the time lost in this way in a certain factory, the writer was called upon during the past summer to arrange the details of an equipment for the factory testing of small direct-current machines, whereby most of the work preliminary to the real test could be avoided. The general scheme of this equipment had already been decided upon.

Most of the machines to be tested are shunt motors, and these are usually of variable speed, the speed variation being obtained entirely by a variable resistance inserted in the field circuit. Seven sizes are provided for in the plan, the smallest being rated at one hp at a four-to-one speed variation, and at about 2½ hp at constant speed, the largest being rated at 15 hp at a four-to-one speed variation and at 40 hp at constant speed. There are also occasionally generators with the same frame sizes as the motors. The majority of the machines are wound for 110 or 220 volts, a few motors being built for 500 to 575 volts for operation from railway circuits, and also some generators of this higher voltage. The tests include the ordinary heat runs and efficiency tests, usually at the minimum speed, and in the case of variable speed motors, a short full load run at maximum speed to observe conditions as to sparking and balance, and to find the resistance needed in the controller for speed control. Other tests are occasionally called for by the designers, in addition to these.

In all, four testing units were built, two of each of two sizes. Each comprises a table and a switchboard, fitted with all necessary instruments and accessories.

Each table is seven feet long. The smaller for machine sizes one to four inclusive, are 30 in. wide and about 21 in. high; the larger, for machine sizes four to seven inclusive, are 40 in. wide

and about 18 in. high. The widths were selected so that the machines will overhang the tables only a little if any, and the heights so that the machines will be at a convenient elevation from the floor for any adjustment, such as setting the brushes, etc., and for measuring speed, applying voltmeter terminals and the like. Both sizes of table are made to take size four machine, a 5-hp motor at a four-to-one speed variation, as this size is made in larger numbers than any other. The tables are framed of 3-in. by 4-in. timbers well braced, and the tops are of 3-in. planking. They are put together with bolts, all bolt heads at the top and on the outside being sunken below the level of the wood.

At each end of the table is a casting fitted to receive a bed movable along the length of the table, so that the beds may be brought together or separated by screws operating the two separately. Each bed has sixteen holes, in four sets of four each, drilled and tapped, each set being spaced to receive the holding down bolts of one of the standard sizes that goes on the table. The sets of holes are so arranged that the central planes of the standard pulleys of all sizes coincide. By this means any two machines of the proper sizes may be placed on the table, belted together, and when the belt is properly tightened it will run steadily, all shafts being parallel and all pulleys having the same central plane. It may be noted in this connection that in this line of machines the holes for the holding down bolts are drilled in jigs, instead of the cheaper but less accurate cored out construction sometimes used, and accordingly can be depended upon to be always in practically the same place in all frames, and to match those drilled to receive the bolts.

Any of the tests for which the outfit is arranged, except a motor run without load, involves the use of a motor and a generator, of which either or both may be actually under test. On this account the switchboard section to accompany any table has a motor and a generator panel, each with the instruments and apparatus for controlling its own machine, and for making the necessary measurements. As a source of power supply, the switchboard is connected to a 110-220-volt, three-wire circuit. When one of the comparatively few machines of higher voltage is to be tested, power is supplied from a factory motor-generator set.

To reduce the field of a motor to 25 per cent of full field, and thus bring the speed up to four times that with full field, requires a resistance of from five to six times that of the field coil, and in series with it. In the case of a 1-hp machine wound for 220 volts, the resistance needed may amount to perhaps 3,000 ohms, while in the case of a 15-hp, 110-volt motor, the resistance needed is small, but it must have a continuous current-carrying capacity of several amperes. This requires on the motor panel of the testing sets under consideration a collection of field rheostats of considerable variety, which are all connected in series, and as much as needed cut into the circuit. These rheostats are partly of high-resistance and partly of large current-carrying capacity. In the field circuit there is also an ammeter, a switch for closing the field circuit and a fuse. The armature circuit has a controller with reversing switch, fuses and two ammeters in series. The first ammeter is of 15 amperes capacity, and is for measuring the current of a motor running light and the load current of small motors, and is provided with a shunting switch, by means of which it can be made inactive when the current is beyond its range. The second ammeter is of a range large enough to carry the current for any motor to be operated from the board, and is left continuously in the circuit. On the motor panel also, before the separation of armature and field circuits, is a circuit-breaker and a double-throw switch for connecting to 110 or 220 volts. The generator panel has a field-circuit arrangement substantially like that of the motor panel, except that there is less resistance and a less variety of rheostats. The armature circuit includes an ammeter, a circuit-breaker, fuses, a set of cast-iron grid rheostats for loading the generator and a double-throw switch with which the generator load can be led to the rheostats or put back on the power line as desired. The load rheostats are placed on the ceiling, above the boards, and have terminal posts on the boards, by which they can be connected in series, multiple or series-multiple, according to the voltage and current of the generator.

Each pair of boards is supplied with a voltmeter having leads long enough so that contact can be made for voltage reading, insulation measurement, etc., at any part of the table. A shelf is placed across the front of the boards at a convenient height, for notebooks, papers or any additional instruments, and an overhead crane can place machines at any part of the tables.

A Topical Classification for Electrical Engineering References.

By George Parsons.

SOME years ago the writer felt the need of a system for filing notes, articles, catalogues and other references, in which such references could be readily located. The alphabetical system was given a thorough trial, but was found to be too cumbersome. A reference was apt to be lost unless thoroughly cross-indexed, since the wording of the title or subject was easily forgotten or might never have been representative of the essence of the subject matter. A topical or subject system was the only apparent alternative.

Careful inquiry showed no such topical classifications well developed. The Dewey decimal classification was of the right type, but was too meagre. Other unpublished systems in use by different individuals were studied, but were found to be too disconnected or too limited. Having given up hope of finding a system to adopt, the writer arranged the headings in the following order:

The fundamental basis of the arrangement is energy and its transformation, i. e., generation, transformation, transmission and utilization. A few of the sub-heads are much the same as in other systems.

Although this system has been in service for between one and two years the author has not experienced many difficulties with it, and it seems superior to all other systems he has found. It requires a minimum amount of cross-indexing, is fairly connected and logical, and may be made as completely comprehensive as desired. It may readily be adapted as the electrical engineering department of a general system for all subjects as the Dewey classification. It is capable of indefinite development in any part according to the needs of the user, e. g., if he be specially interested in one branch as electric railways, he may expand that part by adding sub-heads as desired.

The headings may be used best with card index and filing cabinets guide cards or tabs. In the appended list this importance is indicated by type and marginal indentation.

An example of the use and advantage of this system is here given: Suppose we wish to file a reference on the Cooper-Hewitt mercury vapor lamp. It is perfectly obvious that this falls under *utilization* of electric energy, and under *lighting* where it is naturally filed with Vapor Lighting. Suppose, also, we wish to classify an article on the Moore vacuum tube light. This, of course, goes in the same location and adjoins the above article on the Cooper-Hewitt lamp. Now, let us suppose that a later date the one who originally filed the references, or any other person who may be ignorant of the names of these vapor tube lights, turns to this place, he will find all articles concerning such illumination systems. A stranger could not find the articles if they were filed in an alphabetical system without a great deal of research. The great advantage over the alphabetical system is seen when we consider that under such an alphabetical arrangement one might file the Cooper Hewitt mercury vapor lamp under either C, H, M, V or L. Similar confusion would occur with the other article and the chances are that the articles would not be found together if one wished to study the general subject of vapor lamps.

The above shows some of the features of the system; the greatest satisfaction can come only by comparative trial of this and other systems. This is submitted in the hope that it may prove of aid to those who may be overwhelmed by the difficulties of preserving and locating notes and data.

GENERAL.

Statistics, Specifications, Design, Laws, Management, etc.

GENERATION.

General.
Power plants (General). (Classified alphabetically or otherwise.)
(See also "transformation" and "Transmission" for apparatus.)
" Equipment, Design, etc.
Batteries (Primary.) See also Physics. (For Storage or Secondary see "Transformation.")
Generators (Dynamo-Electric) (also "Motors" if a combined article or reference.)

General.
Dynamos (See also "Utilization," for Motors).
Continuous-Current.
Alternating-current.
Pulsating-current.
Double-current (See "Transformation," for Rotary Converter).

TRANSFORMATION.

General.
Transformers (Alternating to Alternating current).
General.
Constant-pressure.
Series.
Constant-current.
Induction Motor as Transformer.
" Coil.
" Regulator.
Rotary Converter (Continuous and Alternating-Current)
Rectifiers. (Alternating and Continuous-Current.)
Commutating.
Electrolytic.
Secondary Batteries.
Boosters.
Regulators (See also "Transmission" and "Utilization").

TRANSMISSION.

General.
Systems.
Alternating-Current.
Continuous-Current.
Composite (Continuous and Alternating-Current).
Lines.
General. Systems, etc.
Overhead.
General.
Conductors.
Messenger and Cable.
Insulation of.
Poles.
Cross Arms, etc.
Accessories.
Underground.
General.
Conductors.
Insulation.
Conduits.
Manholes, etc.
Interior Wiring, etc.
General.
Systems.
Conductors.
Insulation of wires.
Appliances, etc.
Conduits.
Fuses.
Fixtures.
Switches and Accessories.
Switchboards.
General. (Classification of, etc.).
Power and lighting.
General.
High-Tension.
General.
Switches.
Meters.
Ground Detectors and Auxiliaries.
Protective.
Fuses.
Circuit-Breakers.
Lightning Protection.
Choke Coils.
Arresters, etc.
Low-Tension. (Regulation and control has heading under "Transmission.")
Continuous Current.
Switches.
Meters.
Protective.
Fuses.
Circuit-Breakers.
Lightning Arresters.
Alternating-Current.
General.
Switches.
Meters.
Ground Detectors, etc.
Synchronoscopes.
Auxiliary Apparatus.
Protective.
Fuses.
Circuit-Breakers.
Lightning Protection.
Choke Coils.
Arresters.
Regulation and Control. (See also "Transformation" and Motor Control under "Utilization.")
General.
Measurement.
Systems.
Meters.
Maintenance.
Rheostats
Boosters.
Regulators.
Storage Batteries (See "Transformation").

UTILIZATION.

General.
Solenoids, Magnets, etc.
Heating.
Medicine.
Lighting. (See also "Transmission" and "Wiring.")
Illumination.
General.
Systems.
Arc. Sub-classify "arc," etc., same as Incandescent.
Series, etc.
Vapor and Vacuum Tube.
Incandescent (See "Transmission" for wiring, etc.).
General.
Illumination.
Economy.
Photometry, etc.
Kinds of Lamps.
Apparatus. (See "Transmission," "Wiring").
Intelligence and Signal Transmission.
Signals.
General.
Systems.
Call Bells, etc.
Wiring (See also "Transmission").
Appliances.
Bells.
Buttons and Switches.
Telegraphy.
General.
Systems.
Wire.
Land.
Submarine.
Wireless.
Telephony.
General.
Systems.
Switchboards.
Lines.
Protective.
Other apparatus.
Power.
General.
Systems, etc.
Chemistry and direct products (Electrolytic, etc.).
Storage Batteries (See "Transformation").
Motors.
General.

Systems (Alternating and Continuous-Current.)
Application.
General.
Shops.
Tools and Special Shop Machinery.
General Machinery.
Hoisting, Conveying, etc.
Mining.
Fans.
Traction.
General.
Systems.
Canal Towage.
Automobiles, Electric.
Railways.
General.
Systems.
Installations.
Power Plants (See also "Electric Generation").
Equipments.
Sub-Stations.
Transmission (See also "Electric Transmission" above).
General.
Feeder and Transmission.
Track.
Cars, Trains and Locomotives.
General.
Equipment.
General.
Heat.
Light, etc.
Motors and Motive Equipment.
Motors of Car, etc.
Multiple-Unit Equipment.
Locomotives.
Stations, Depots, Terminals, etc.
Accommodations.
Business, Rates, Traffic, etc.
Construction, Repair and Test.

A Method of Testing Wireless Receivers.

By GREENLEAF W. PICKARD.

IN the experimental investigation and development of oscillation detectors, it is frequently necessary to determine their sensitiveness to very feeble high-frequency oscillations when a commercial wireless telegraph station is not immediately available for this purpose. In such tests it has been the common practice among experimenters to set up miniature sending and receiving antennae placed a short distance apart, energizing the sending antenna, a simple ungrounded Hertzian oscillator, by means of a small induction coil. With this method the writer has had much unfavorable experience. Owing to the small dimensions of the oscillator, the oscillation frequency is many times that employed in commercial wireless telegraphy, and small changes in the adjustment of the spark-gap length or polish of the knobs greatly changes the amount of radiation. Further, the close proximity of the oscillator makes it difficult to eliminate the disturbing effects of electrostatic induction, which superimposes upon the high-frequency oscillations in the receiving antenna a relatively low-frequency current, often of considerable magnitude. Lastly, it is not possible to make more than the roughest guess at the e.m.f. impressed upon the terminals of the detector, so that quantitative measurements are entirely out of the question.

The method employed by the writer utilizes a closed oscillating circuit adjusted to the desired frequency, which is carefully shielded from the detector under test, but is connected thereto through a circuit of impedance so great that the resistance of the detector forms but a negligible part of the impedance. This is accomplished by inserting a variable air condenser of extremely low capacity in the circuit. Under these conditions the flow of current through the detector is governed solely by the value of the capacity, the impressed e.m.f., and the frequency. As the oscillating circuit, the air condenser, and the detector are separately shielded from each other and from external objects, the electrostatic capacities of these circuits are fixed quantities, with the exception of the air condenser, and movements of the observer are therefore without effect.

The diagram illustrates the arrangement of apparatus, circuits and shields. M is a shield of tin or sheet zinc, forming a rectangular box with three compartments, which are fitted with metallic covers or doors giving ready access to the compartments. The compartment on the right contains the battery, key, and induction coil, together with the oscillating circuit. The induction coil, I, the spark length of which is preferably one inch or less, charges the condenser, C_1, which discharges across the spark-gap, S, through the inductance helix, L_1, thereby setting up oscillations of a frequency depending upon the values of the capacity and inductance. One terminal of the inductance helix is connected to the shield, while from an intermediate point along the helix a lead is taken through the detector to be tested, one terminal being connected to the plate, P_2, of the variable air condenser, C_2, in the middle compartment. The other plate of this condenser is made movable, being attached to a stout wire which slides easily in the glass tube leading to the left hand compartment. In this latter compartment is placed the detector to be tested, one terminal being connected to the plate, P_1, of the air condenser, and the other to the shield. The local circuit of the detector passes out of the shield to the telephone receiver or galvanometer, T, a suitable choke coil, L_2, being interposed on the air condenser side of the detector.

Although a practically unlimited range of oscillation frequencies may be obtained, it is well to select some one frequency for the tests. In commercial wireless telegraphy, the frequencies may

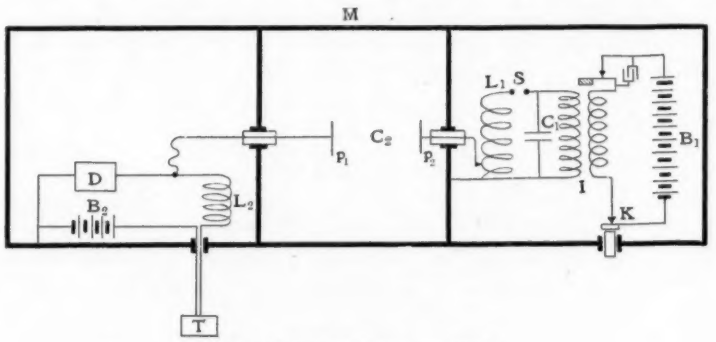


DIAGRAM OF TESTING CIRCUITS.

range from five hundred thousand or less up to over a million periods per second, and for the purposes of detector testing, a million periods per second will be found an excellent standard. To obtain this frequency, a small Leyden jar or glass-plate condenser of one thousandth microfarad may be used in the oscillating circuit, discharging through an inductance of twenty-five microhenries. A simply constructed helix having this inductance may be built on a pasteboard mailing tube, two and a half inches in diameter, and eight inches long, by winding on a helix of thirty-six turns of No. 18 copper wire, so spacing the turns that the entire length of the tube is covered by the helix. After securing the ends of the winding, the tube and helix should be dipped in paraffine, both for insulation and to prevent the wire from slipping out of place.

As shown in the diagram, one terminal of the helix is connected to the shield, while a tap is taken from an intermediate point along the helix to the air condenser. The position of this point determines the potential across the condenser, and in consequence the current through the detector, so that for purposes of rough adjustment several taps should be brought out along the helix. If, as should be the case, the spark-gap, S, is set at one millimeter, the potential across the terminals of the helix will be approximately 4,000 volts. Connecting the condenser tap to the first turn from the end connected to the shield, the potential impressed upon the air condenser will evidently be one-thirty-sixth of this, or about 110 volts. Knowing the capacity of the air condenser, the current through the detector may easily be calculated. The detector circuit includes one turn of the inductance helix, L_1, the air condenser, C_2, and the detector, D, being completed through the shield M. The current in this circuit will evidently be

$$I = \frac{110}{\sqrt{R^2 + \left(\omega L - \frac{I}{\omega C}\right)^2}}$$

and, as both R and L are very small relatively to $\frac{I}{\omega C}$, this reduces to

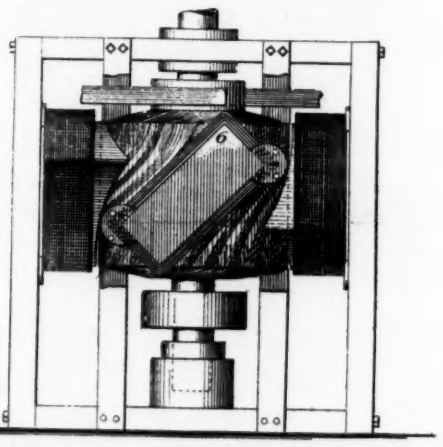
$$I = 110\omega C \text{ amperes.}$$

With the exceedingly sensitive detectors now used in wireless telegraphy, the current strength required to give an observable signal is very small. By making the plates, $p_1 p_2$, in the form of metal discs one centimeter in diameter, and separating them several centimeters, the capacity may be reduced to less than one-hundredth of a micro-microfarad, and the current to a fraction of a micro-ampere.

Not only may this method be used for testing oscillation detectors, but it affords a source of oscillatory current suitable for testing tuned receiving circuits, giving current values comparable with those obtained in commercial wireless telegraphy over long distances. As the damping in the oscillating circuit is comparatively small, the oscillations are persistent, corresponding to those used in high-power wireless stations.

Vertical-Shaft Direct-Current Generator.

In a patent issued November 14, Mr. Morris Schwartz proposes to construct direct-current generators with rectangular pole pieces having their major axes inclined at an angle of substantially 45° with the vertical shaft of the machine. The armature conductors are disposed in helixes substantially parallel with the major transverse axis of the pole piece as they pass its face. The force between the armature conductor and the field magnetism is exerted at right angles to the direction of the conductor. The vertical

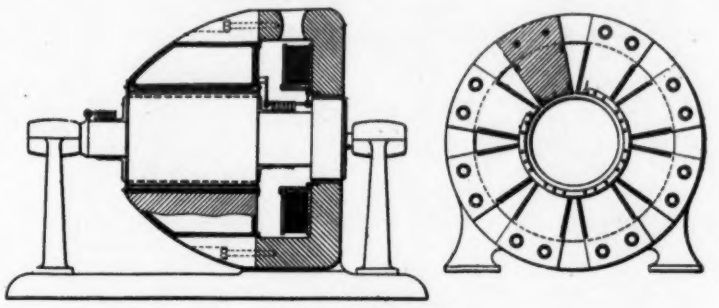


VERTICAL-SHAFT, DIRECT-CURRENT GENERATOR.

component of this force, which does not represent power, is in a direction to oppose the action of gravity upon the armature, and the step bearing will be relieved of a portion of the weight of the armature, so that the principal frictional resistance is reduced. It is intimated in the specification of the patent that the whole force existing between the armature current and the field magnetism is effective in producing electrical power, while only the horizontal component of the force is represented in the torque which the prime-mover must supply. It would be interesting to learn what efficiency is expected from a machine of this construction.

Homopolar Dynamo.

A patent issued November 14 to Dr. C. P. Steinmetz relates to the construction of generators of the unipolar type, and deals with details tending to eliminate the armature reaction, which has rendered the regulation of such machine very poor. The armature winding consists of straight conductors, each of which is connected at each end to a collector ring, the circuit being completed through cross-connections between the collector rings external to the armature. The currents flowing in the armature are in the same direction in all of the conductors, and they tend to produce a circular flux, which is mechanically at right angles both to the conductors and to the normal field flux. This circular polarization results in an increased flux density in the field structure, a reduction of the total useful flux and a consequent decrease of the terminal voltage of the machine. The inventor increases the reluctance of the path of the circular flux by means of the polar construction shown in the illustration, wedge-shaped radial air-gaps interrupting the circumferential continuity of the field structure. An interesting feature of the invention resides in the use of shunt-connected field coils for the purpose of compounding the machine. In addition to the normal shunt-connected self-exciting field coil, the inventor uses other coils placed so as to produce at all times a circular polarization opposed in direction to that due to the armature current. These auxiliary shunt-connected field coils are placed so as to produce a constant



HOMOPOLAR DYNAMO.

circular polarization. When the armature is on open circuit this circular polarization will be unopposed, and an increased density will be produced in the field poles. Now, as the armature is loaded the tendency to circular polarization by the current in the armature will oppose the polarization due to the auxiliary field coils. Thus the circular polarization will be reduced, the density will be reduced and the total useful flux due to the exciting field coil will be increased and the terminal voltage of the machine will be raised.

LETTERS TO THE EDITORS.

American Inventors and the German Patent Office.

To the Editors of Electrical World and Engineer:

SIRS:—I notice on page 809 of your current volume an interesting letter from the President of the German Patent Office. I believe that we are treated absolutely as well as are the Germans themselves.

During a residence of thirteen years in Germany, I had frequent dealings regarding German patents taken out by foreigners. It was also a part of my routine duty as a managing director of an electric manufacturing company, to supervise the work of its Patent Department. In this connection I often felt that there were plenty of difficulties connected with German patents, and I heard many complaints on the shortcomings of the patent system. From time to time it has met with bitter criticism from well known technologists and patent lawyers. I remember such a criticism published by Dr. von Hefner-Alteneck, and another from Prof. Riedler. Most critics have referred to the lack of definiteness in the practice. There is certainly a feeling that one can never foretell what view of a case the patent office will take. The great divergence in decisions where analogous conditions have existed is bewildering. I have never heard any German deny the desirability of improving the system and more closely defining the rules of practice. I believe, however, that most of the *discontent among Americans, can be traced to the same troubles that Germans complain of*. I believe that the Germans are especially objective and are, as a rule, able to apply themselves impartially to the "materia," without being influenced by external circumstances. My experience with Germans, in general, and my acquaintance with some of those connected with the patent affairs, makes me confident that they do not discriminate against Americans or any other foreigners.

It will be remembered that after the German Patent Office has made its search and decided to grant a patent, the patent draft is laid out for public inspection. The sharpness of trade competition thus enters to increase the severity of the examination. A turbine builder, for instance, is immediately informed by his patent agent in Berlin for an improved turbine about to be patented and naturally makes every effort to find a prior reference. Thus the experts of a whole industry, and not the Patent Office itself, stand

responsible for the ultimate refusal or narrowing down of a patent. I remember one case, for instance, where an Englishman doing a large business in his own country, was about to receive a German patent, but he was prevented therefrom by an American. In this way an American who is well informed on the previous state of the art is sometimes in a position to prevent a German from getting a patent.

Instead of sending simply the copy of an American application, it would usually improve the chances of obtaining a good patent if the inventor would send additional explanatory matter. One should select a good attorney in Germany and get into close contact with him directly or through one's American attorney. A good many applications are sent by the American attorneys to some large London office. There they are translated and sent on to German correspondents, thus that sense of direct personal contact is lost which is so valuable in all business. After getting a correspondent in Europe, whose capabilities are known to you, you must trust him to clothe the invention in such a form as to meet his conception of German practice. In translating *language* effectively we not only substitute words, but, at the same time, change from the spirit of one language to that of another. So, too, the essence of an *invention* must be clearly transferred to the European attorney, so that he will understand it and be able to fight for it. The German Patent Office is usually amenable to explanation and enlightenment.

It often happens that, for lack of novelty, the invention as originally proposed, is refused, and the patent, as granted, is narrowed down to details. These alterations, which sometimes are of eminent importance, take place in the course of the routine and frequently fail to come properly to the attention of the inventor or patent owner. The inadequacy of the claims to properly cover the article as put upon the market, frequently, therefore, appears some years later when the inventor attempts to sell his European rights. If all inventors would insist upon seeing the objections of the Patent Office and then assist their attorneys in preparing answers to these objections, the results would certainly be more satisfactory. This is especially true of patent applications on subjects regarding which technical practice is not very well established.

NEW YORK. LOUIS J. MAGEE.

Approximations of the B. & S. Gauge.

To the Editors of Electrical World and Engineer:

SIRS:—I read with much interest the letter of Mr. W. F. White in your issue of October 14, showing a simple slide-rule formula for determining the size of wire to use under the usual conditions. I find, however, that Mr. White's process can be simplified by the elimination of one step, and the result can be reached more directly than he has shown.

To ilustrate the step which is unnecessary let us take an example under Mr. White's rule, assuming the following conditions:

$V = 3.5$ = drop in volts,
$D = 74$ = distance in feet,
$I = 95$ = load in amperes.

From Mr. White's formula (8),

$$n = 36.99 + 10 \log \frac{V}{D\,I} \qquad (1)$$

substituting,

$$n = 36.99 + 10 \log \frac{3.5}{74 \times 95} \qquad (2)$$

$$= 36.99 + 10 \log .000498 \qquad (3)$$

From the slide-rule it is seen that

$$\log .000498 = -4.697 \qquad (4)$$

It is right here that the difficulty arises, because the figure —4.697 is not the *real* logarithm of .000498, and consequently it cannot be used in solving formula (3). This is owing to the fact that the characteristic (—4.) is negative and the mantissa (.697) is positive. The real *log*, therefore, and the one that must be used in the solution of the problem, is,

$$-4.000 + .697 = -3.303 \qquad (5)$$

Substituting this figure in (3) gives,

$$n = 36.99 - 33.03 \qquad (6)$$
$$= 3.96, \text{ or approximately No. 4 wire.}$$

This unnecessary step can be eliminated as follows:
From (1),

$$n = 36.99 + 10\,(\log V - \log D\,I). \qquad (7)$$

$$= 36.99 - 10\,(-\log V + \log D\,I). \qquad (8)$$

$$= 36.99 - 10 \log \frac{D\,I}{V} \qquad (9)$$

Taking the same conditions as before,

$$n = 36.99 - 10 \log \frac{74 \times 95}{3.5} \qquad (10)$$

$$= 36.99 - 10 \log 2010 \qquad (11)$$

The slide-rule gives directly,

$$\log 2010 = 3.303 \text{ (see formula [5])} \qquad (12)$$

and substituting in (11),

$$n = 36.99 - 33.03$$
$$= 3.96, \text{ or approximately No. 4 wire.}$$

WATERLOO, IOWA. AUSTIN BURT.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Three-Phase Motors Operated from Single-Phase Mains.—DALEMONT.—An article on the use of three-phase motors on single-phase systems (especially for traction) with the aid of an inductance and a capacity. In connection with his monocyclic starting system, Steinmetz has shown that by varying an inductance and a capacity

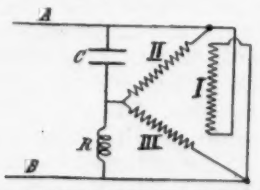


FIG. 1.—DIAGRAM OF CONNECTIONS.

it is possible to vary the torque of a three-phase motor. The present author discusses the operation of three-phase motors under such conditions, not during starting, but during the continuous running period. By means of Steinmetz's symbolic method he shows that a three-phase motor may be operated advantageously from single-phase mains if connected as shown in Fig. 1, where I, II, III are the three-phase windings of an ordinary three-phase motor, *C* a condenser, *R* an inductance and *A B* single-phase mains. He shows that the phase I is to be connected in a direction reversed to the ordinary one. He then gives the results of some experiments obtained with a small single-phase motor of a normal capacity of 1 hp at 1,500 r.p.m. This motor was first supplied from a three-phase circuit and the results of the tests are given in Fig. 2. Tests were then made with the same motor on single-phase mains, the connections being like those in Fig. 1, but phase I being connected in the ordinary way; that is, in a direct opposite to that in Fig. 1. Finally tests were made with the same motor connected exactly as shown in Fig. 1, the results being given in Fig. 3. Steinmetz has shown that it is possible to change the starting torque by means of this

arrangement, while the author says that his tests show that the motor may be operated advantageously in this way for continuous

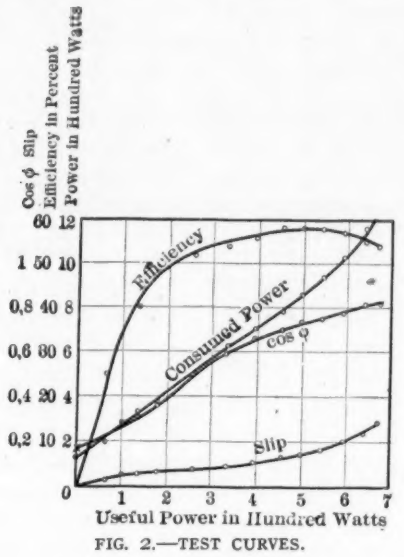


FIG. 2.—TEST CURVES.

running. He calls attention to the high value of the power factor. He thinks it would be possible to use three-phase motors in this way for traction, only one overhead conductor being required. He

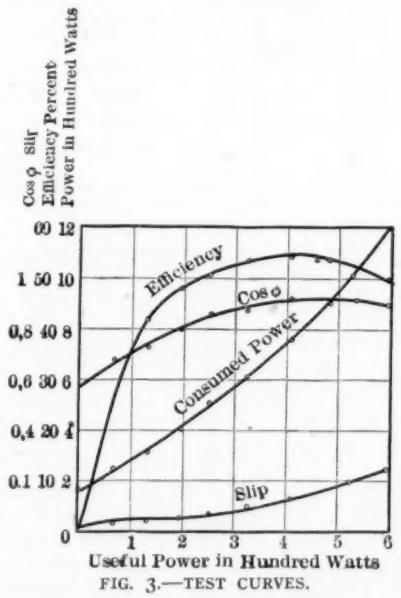


FIG. 3.—TEST CURVES.

remarks, however, that condensers have not yet been introduced to a great extent in engineering practice.—*Elek. Zeit.*, November 2.

Auxiliary Poles for Single-Phase Motors.—A note stating that the Siemens-Schuckert Co. has been granted a Swiss patent for a new method of preventing or reducing sparking in single-phase series motors. It is pointed out in the patent specification that the voltage induced in the coils undergoing commutation by the alternating-field flux lags 90° behind the main current. If the coils on the auxiliary poles were in series with the armature, the flux from the auxiliary poles would pass through zero value at the time the "transformer voltage" in the short-circuited coils is at its maximum. In order to bring the current more into phase with this voltage, the auxiliary coils, together with suitable resistances and choking coils, are connected in shunt across the armature.—Lond. *Elec.*, November 3.

Generators in Parallel.—BOUCHEROT AND MONGIN.—Two papers presented before the International Society of Electricians in Paris. A brief paper by Mongin proves that the regulator of a prime-mover, acting by centrifugal force, operates like a damped pendulum system. The paper of Boucherot deals with the general problem of the influence of prime-mover regulators on the operation of electric generators in parallel. This problem is discussed mathematically from a very general point of view.—*Bull. de la Soc. Internat. des Elec.*, July.

Liege Exposition.—REYVAL.—An illustrated description of a generating set exhibited at Liege. It consists of a 600-hp steam engine, driving a 400-kw direct-current dynamo of the Jasper Company, the voltage being 440 to 480 for a speed of 110 r.p.m. Drawings of the dynamo are given with detailed dimensions.—*L'Eclairage Elec.*, October 21.

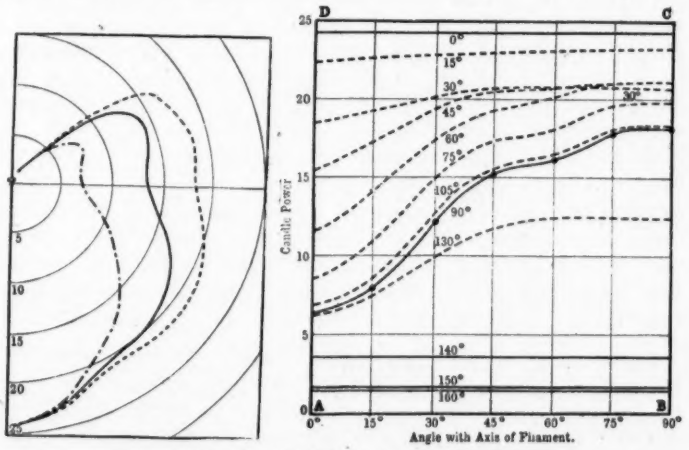
Compensated Repulsion Motor.—BETHENOD.—A mathematical note on the theory of the Lehmann compensated repulsion motor, which was recently described in the Digest. The present author offers some criticisms.—*L'Eclairage Elec.*, October 21.

LIGHTS AND LIGHTING.

Absorption by Lamp Globes; Determining the Mean Spherical Candle-Power.—SOLOMON.—An account of some tests made with Nernst lamps to determine the absorption of light by globes. This was found to be much smaller than is generally assumed. But the author agrees that the Nernst lamp is not very well suited for just such an investigation. The results of tests of a Nernst lamp with 200 volts at 0.96 amp. made by the Allgem. Elek. Ges. is given in the following table:

	No. Globe.	Clear Globe.	Frosted Globe.	Holophane Class A	Holophane Class B
Mean horizontal candle-power	199.5	113.5	95.5	57	91.3
Candle power vertically downwards	20.0	13.5	44.5	177	91.5
Mean hemispherical c.p. (upper)	77.0	78.0	74.5	50	41.0
Mean hemispherical c.p. (lower)	85.0	86.0	82.5	96	100.0
Mean spherical candle-power	81.0	82.0	78.5	73	70.5

It will be seen that the mean spherical candle-power is larger for a clear globe than for no globe. This is due to the filament burning in a hot atmosphere if a globe is used, and not being subject to the cooling action of air currents. The author has devised a new method of determining the mean spherical candle-power which is applicable to all unsymmetrical light sources. It is as follows: The distribution of light in three planes was measured experimentally (*a*) the horizontal plane through the filament, (*b*) the vertical plane at right angles to the filament, and (*c*) the vertical plane through the filament. The distribution curves obtained in (*b*) and (*c*) are shown in Fig. 4. The curve consisting of dots and dashes



FIGS. 4 AND 5.—ABSORPTION BY LAMP GLOBES.

gives the distribution in plane of glower; the curve consisting of dashes only gives the distribution perpendicular to the glower. As the Nernst filament is a straight rod the horizontal distribution curve may be divided into four similar quadrants, and it is necessary in what follows to consider only one such quadrant, the value of the candle-power at the various angles in this being taken as the mean of the values for the corresponding angles in all four quadrants. These values are plotted as a curve (90°, Fig. 5) to rectangular coordinates, the abscissæ representing angles made with the axis of the filament and the ordinates representing candle-powers. The mean height of this curve, which can be found by measuring its area with a planimeter, represents the mean horizontal candle-power. Consider now the distribution of light below the horizontal. If a sphere be described around the source of light and be divided into a number of horizontal zones the mean spherical candle-power can be obtained by Rousseau's method, the mean intensity of light on each zone being known. The problem, then, is to find the mean value of the candle-power for each zone, or, in other words, the mean candle-power along the surface of a cone having a given vertical angle, and to obtain this it is necessary to determine the distribution of light for this particular angle. The distribution for a cone having a vertical angle of 0°., i. e., in a direction vertically downward, is obviously a circle, and hence is represented on the curve sheet by a straight line (0°, Fig. 5). For this reason both

the curves 0° and 90° are drawn in full, as both may be considered as determined experimentally. When passing from the horizontal plane to the vertical, the curve of distribution must obviously change gradually in shape from that of curve 90° to that of curve 0°; but the starting and finishing points of all these curves are already known, since they have been determined in the measurements of vertical distribution in the two vertical planes at right angles. The values found in the plane of the filament are plotted on the ordinate, *A D*, and those found in the plane at right angles to the filament on the ordinate, *B C*. These points are then joined by a series of curves merging gradually from the shape of the curve 90° to that of curve 0°. These curves are shown in the diagram for angles of 15°, 30°, 45°, 60° and 75° with the vertical; they are shown dotted, as only the first and last points are actually observed values. By measuring the area of any one of these curves the value of the mean candle-power is obtained. In a similar way the mean candle-power for angles above the horizontal can be obtained (105° to 160°). If the mean values thus obtained be now plotted as a vertical distribution curve, the full-line curve in Fig. 4 is obtained, which represents the vertical distribution for an axially symmetrical source of light having the same mean spherical candle-power as the lamp, and from which the mean spherical candle-power can be obtained by the usual graphical construction.—Lond. *Elec.*, November 3.

POWER.

Electric Power and Fuel in San Francisco.—The extent to which fuel oil and electric power are entering into manufacturing and all other development and producing enterprises in California is shown by the reduction of coal imports at San Francisco. During the last four years these deliveries have been as follows: 1904, 1,051,072 tons; 1903, 1,215,554 tons; 1902, 1,445,598 tons; 1901, 1,834,785 tons. During the same years the oil production has been as follows: 1904, 29,850,000 barrels; 1903, 23,602,000 barrels; 1902, 13,692,514 barrels; 1901, 8,654,500 barrels. In steam-producing capacity, it requires four barrels of oil to equal one ton of coal. In the four years receipts of coal have decreased 783,713 tons. This would be compensated for by 3,134.852 barrels of oil, but the oil production has increased 21,095,500 barrels, or relatively nearly seven times the decrease of coal. This illustrates the growth in industrial and manufacturing development of California. The State has never in its history imported as much as 1,900,000 tons of coal in a year. In 1904 the coal imports and oil production combined equalled 8,513,517 tons of coal, or in 1904 there was considerably more than four times the available steam-producing power than in 1901. In 1904 there were 85,000 electrical hp in San Francisco, while in 1901 there were about 40,000 hp. Most of the electric power is transmitted from the Sierra Nevada Mountains.—*Jour. of Electricity*, November.

Electricity in Power Engineering.—ESSON.—The conclusion of his presidential address to the Civil and Mechanical Engineers' Society on the influence of electricity on power engineering. He discusses the new phenomena introduced into transmission problems by the rise of voltage in recent years. He emphasizes how much electricity has done for the mining industry. "I am not thinking of its use for power distribution in and about coal mines, though on the continent this has now attained gigantic proportions, but of the reduction in operating costs effected by the utilization of distant water power through the medium of electricity, mines which under the old régime could not have been made to pay, have been opened up, while those that previously had just been clearing expenses have been enabled to pay dividends. It is estimated that the Sheba mine saved $50,000 per year by introducing electric transmission, owing to the ore being then crushed in the mine, instead of transported by aerial rope-way to a mill on the bank of a river 2¼ miles away." The paper is concluded by some remarks on turbine and gas engine construction.—Lond. *Elec.*, October 27.

Cranes.—HOWLETT.—A well-illustrated article on locomotive cranes as labor savers.—*Cassier's Mag.*, November.

Mechanical Stokers.—BENNIS.—A paper discussing the advantages of mechanical stokers.—Lond. *Elec.*, October 27.

Peat as Fuel.—STILLINGS.—A discussion of the use of peat as fuel, with a description of machines for forming peat.—*Electrochem. and Met. Ind.*, November.

Peat as Fuel.—COLLINS.—An illustrated article on the present status of the peat fuel industry in the United States.—*Scient. Am. Sup.*, November 18.

TRACTION.

Berlin.—Two new projects for railways in the City of Berlin. It is pointed out that in traction facilities Berlin is behind Paris, New York, London, Chicago and Boston. The first project is that of the Grosse Berliner Strassenbahn for two subway roads. The current is supplied through a trolley wire on the upper wall of the tunnel. The second project is for a North-South line, and has been devised by the Continentale Gesellschaft für Elektrische Unternehmungen. This project is very remarkable since it contemplates a suspended railroad of 12 km. length. Along the line contemplated the construction of tunnels would offer considerable difficulties. On the other hand, a suspended road is believed to have distinct advantages over ordinary elevated roads; first, the width of its construction is smaller; it is thought to look better, and finally curves of 50 meters radius can be passed safely at the same speed as curves

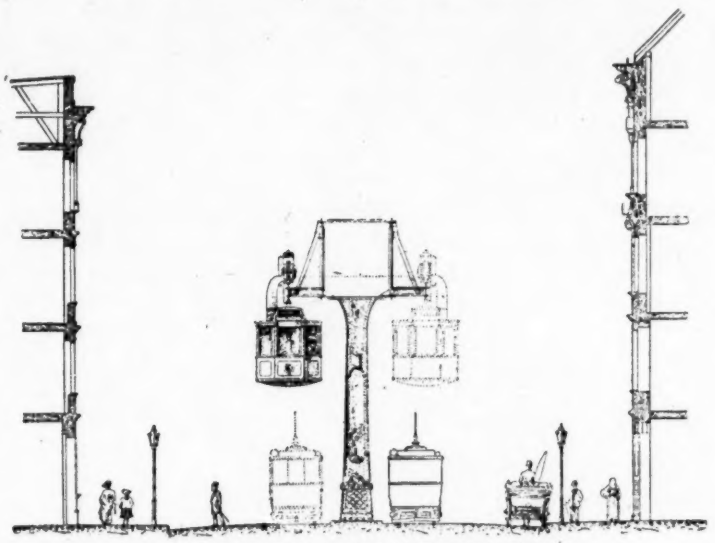


FIG. 6.—BERLIN SUSPENDED RAILWAY.

of 200 meters on ordinary elevated roads. This is the result of the experience with the suspended railway between Elberfeld and Barmen. The latter has been in operation since 1899, has carried 40,000,000 passengers and has fulfilled all expectations to such a degree that the suspended road in Berlin will be constructed on the same system. An idea of the construction may be gotten from Fig. 6.—*Elek. Zeit.*, October 26.

Alternating-Current Locomotives on the New York and Stamford Division.—SPRAGUE.—His reply to some of the criticisms which had been offered against his original criticism of the decision of the New Haven road to adopt alternating-current locomotives for operation on the New York and Stamford division. He maintains his original standpoint and believes that he is "a better friend of rational alternating-current development, applied in a rational way to railway operation, while maintaining that the limit of direct-current operation is by no means reached, than a majority of those who sing its praises on a single strident, but ofttimes unmusical note"—but he is unwilling to see its present injection into the densest section of the train movement of two great railway systems, "with almost inevitable adverse consequences."—*St. R'y Jour.*, November 11.

Tramway Station.—REYVAL.—An illustrated description of the Sclessin Station, which supplies power for the electric tramway from Liege to Seraing. It contains two 2,700-hp steam turbines. Each turbine drives an alternator of 1,500 to 1,800 kw, a direct-current dynamo of 750 to 850 kw, giving traction current at 550 volts, and an exciter for both generators.—*L'Eclairage Elec.*, October 14.

Unit of Acceleration.—MAILLOUX.—A communication concerning some units used in American traction practice. He shows why the American short ton of 2,000 pounds is far more convenient than the English ton of 2,240, and that the only logical unit of acceleration for practical use is the "mile per hour per second."—Lond. *Elec.*, October 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity in Department Store.—WEIL.—An illustrated article on the electric installation of the Oberpollinger department store in Munich. Comparative estimates showed that the operation of an

isolated plant either with suction gas engines, Diesel engines or steam engines would have been less expensive than buying the electric power from the municipal supply network. For this reason a sub-station has been established in the basement of the store. It contains two three-phase, direct-current, 575-hp converters, and a storage battery. For lighting a department store arc lamps have so far been used almost exclusively in Germany. In this case the Nernst lamp has been introduced to some extent on account of its white light and of the artistic appearance of the lamps. Two floors are equipped with Nernst lamps and two with arc lamps, while the other floors are lighted either with arc lamps, Nernst lamps or ordinary incandescent lamps, according to the requirements of the case. There are six electric elevators and a complete telephone, fire alarm and electric clock installation.—*Elek. Zeit.*, October 26.

Electricity at a Modern Hotel.—An illustrated article describing the engineering features of the Gotham Hotel, New York City. Direct current at a potential of 250 volts is used for both lamps and motors. The various motor applications are described.—*Am. Elec.*, November.

ELECTROPHYSICS AND MAGNETISM.

Sodium Vapor.—WOOD.—An account of an experimental investigation of the fluorescence of sodium vapor and the resonance radiation of electrons. The author has ascertained the very remarkable fact that the stimulation of the vapor with approximately monochromatic light furnished by a monochromatic illuminator (spectroscope), results in the emission of light, the spectrum of which consists of a number of more or less regularly spaced bright lines of different intensities. The slightest change in the wave length of the exciting light results in the disappearance of these lines, and the appearance of another set; the phenomenon indicating that the molecule contains a number of groups of electrons, the excitation of any one of which sets the entire group in vibration, without, however, disturbing the other groups. As the wave length of the exciting light is slowly changed, the fluorescent spectrum presents a most remarkable appearance. The lines appear in rapid motion, the luminous bands moving in a rippling manner, like moonlight on water. The motion is of course an illusion, due to the continual disappearance and reappearance of the bright lines, the phenomenon reminding one forcibly of the scintillations produced on a screen of zinc sulphide by the electron bombardment produced by radium. Concerning the bearing of his results on our molecular views, the author speaks as follows: "These experiments show in a striking manner the complexity of the piece of machinery which we will call the sodium molecule. Professor Rowland once said that a molecule is much more complicated than a piano. In most cases all that we have been able to do is to strike the entire keyboard at once, but in the case of sodium it seems possible to strike one key at a time. A study of the fluorescent spectra of other vapors will doubtless do much to clear up the mystery of the mechanism of molecular radiation."—*Phil. Mag.*, November.

Linear and Rotating Hysteresis.—WECKEN.—There are two different methods by which the magnetization may be made to pass through a complete cyclic process. The first is a continuous change of the magnetizing force, while the direction of the core with reference to the coil remains always the same. The second is a continuous rotation of a magnetized body in a magnetic field of constant direction and constant intensity. In the first case the author speaks of linear hysteresis, in the second case of rotating hysteresis. He has carried out a set of measurements to find whether the hysteresis is the same in the two cases. For cast iron the results are given in the following table:

B max.	*Ar* Ergs.	*Al* Ergs.	$\frac{Ar}{Al}$	
2,000	455	375	1.214	
4,000	1.200	1.075	1.117	
6,000	2.160	1.930	1.119	mean
8,000	3.425	3.030	1.130	1.171
10,000	5.120	4.350	1.176	
12,000	7.220	6.100	1.184	
14,000	10.175	8.530	1.194	
16,000	14.700	11.860	1.240	

B max represents the maximum magnetic induction, *Ar* the hysteresis loss for revolving hysteresis, *Al* the hysteresis loss for linear hysteresis, both these values being given in ergs per cubic centimeter. The last column gives the ratio of the revolving to the linear hysteresis loss. Similar tests were made with steel and cast iron and it was found that this ratio is almost the same in all three cases, the average value being 1.2. It is probable that for higher magnetic inductions this ratio will be larger. Under the supposition that Steinmetz's formula, $A = \eta\, Bmax^{1.6}$, is exact, the hysteresis coefficient η, was determined by the author and is given in curves in Fig. 7. It will be seen that this coefficient is not constant. Even for linear hysteresis, there are evident differences for wrought iron. With rotating hysteresis the formula cannot be applied to high values of the induction. For cast iron the error of the formula is in-

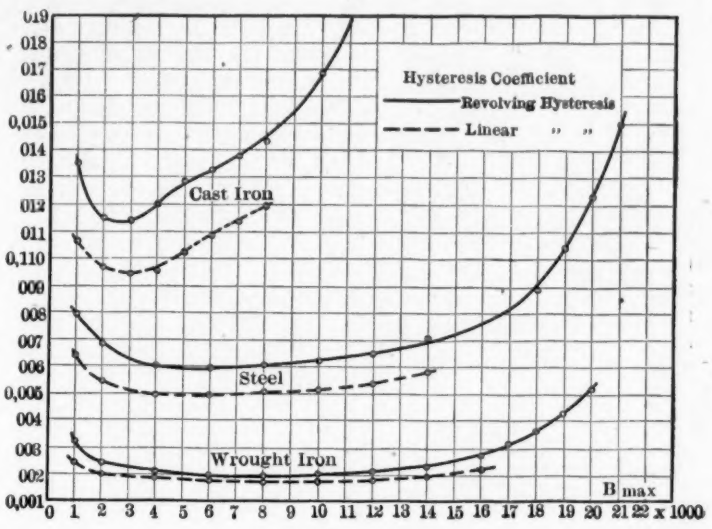


FIG. 7.—HYSTERESIS CURVES.

applicable either for linear or for rotating hysteresis.—*Zeit. f. Elek.* (Vienna), November 5.

Magnetic Alloys from Non-Magnetic Metals.—HILL.—An article on the irreversibility of the Hensler alloys. Experiments were made by him with an alloy containing about 60 per cent copper, 25 per cent manganese and 15 per cent aluminum. A rod formed of this alloy was tested at varying temperatures, the same being first increased and then again decreased. The results are shown in Fig. 8. Be-

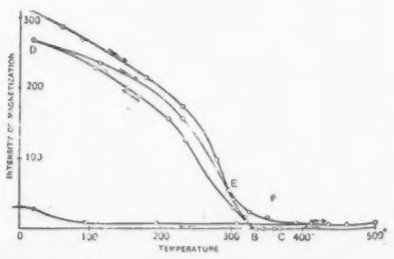


FIG. 8.—CURVES SHOWING RESULTS OF TESTS WITH ALLOYS.

ginning at *A* with an intensity of $I = 311$ c.g.s., the curve falls till it reaches the axis at *B*. The temperature was carried 33° higher, bringing the curve to *C*. On cooling the line leaves the axis again at *B*, but does not return to *A*, but to a lower value at *D*, $I = 267$. With the second heating the curve lies above that for the first cooling, and does not come to the axis at *B*, but crosses the former heating curve at *E*, and when heated to 500° C. retains a slight susceptibility, *I* being equal to 7. After falling the second time to 17° C., the intensity was only 27; that is, the susceptibility was only 0.32. A reading was taken with the specimen in liquid air, giving $I = 36$. This remained unchanged when room temperature was again reached.—*Phys. Rev.*, November.

ELECTROCHEMISTRY AND BATTERIES.

"Kupron" System.—In notes on the recent Olympia Exposition in London a large assortment of various articles manufactured by the "Kupron system" of a British company is mentioned. These articles varied in size from a small "flush" switch cover to an entire shop front. The process of manufacture is an exceedingly simple one, and it is only the development of it in this particular direction that is at all novel. First of all, the electric light fitting, or whatever it may be, is modeled in clay and the clay is then covered with a thin film of blacklead. By immersing the latter in a copper bath a layer of copper of any desired thickness is electrolytically deposited on the mould. The finish is bronze, silver, gold or any other style and the amount of labor entailed by the process is said to be very small. "The chief advantage of the process is the low cost of

the finished article, electric light fittings and other things of a similar kind costing not more than half what they would have cost if produced in the ordinary way." The process adapts itself to plating articles of very different shape.—Lond. *Elec.*, October 27.

Units, Measurements and Instruments.

Testing Earth Connections.—Corsepius.——For safety purposes frames of electric machines, etc., are often earthed. The purpose of the earth connection is to make sure that any currents which may pass from the frame, etc., to earth will pass through the earth connection and not through a person who may be in contact with the frame. If such earth connections shall be effective, it is necessary to keep them in good order and to test them regularly. The author points out that tests made with small voltages, such as used with the testing bridge and the telephone, are not so reliable as tests made with higher voltages. In the case of an alternating-current installation the author recommends to use the supply current itself for testing, of course, through the intermediary of the transformer, while for direct-current testing a small storage battery is used. Two different connections are shown for testing, one for direct-current testing and the other for both direct and alternating-current testing. By his method he has found the following values: An earth connection consisting of a large 1 by 1.5 meter sheet iron plate with a copper cable, screwed and soldered to it at various places, had a resistance of about 7 ohms. Wire used as earth connections, as is often done with lightning rods, had a resistance of about 50 ohms. Lead pipes, of 20 mm. external diameter, 10 meters long and embedded in a trench 1.2 meters deep, showed resistances of about 6.5 to 8.5 ohms, and are considered by the author as quite advantageous. Underground pipes which belong to a large network, such as water pipes and gas pipes, have a very low resistance.—*Elek. Zeit.*, October 19.

Anti-Vibration Suspension.—Julius.—The author who is the inventor of the anti-vibration suspension named after him, points out that its principles are not yet sufficiently grasped by manufacturers. It must fulfil five conditions to be effective. The three wires of the suspension must be of equal length, equally loaded and perceptibly stretched. The center of gravity of the whole suspended body must be in the horizontal plane containing the bearing ends of the wires. Those parts of the apparatus whose freedom from disturbance is most important must be near the center of gravity. Vertical shocks must be eliminated by introducing a short length of spiral spring into each wire. And, lastly, the proper vibrations of the suspended body must be damped by liquid immersion or cotton wool, mounted in the plane containing the center of gravity. If the apparatus on the suspension must be frequently handled it is best to have a clamping device. This consists of a triangular frame mounted on a table and surrounding the triangular plate of the suspension on all sides within 1 cm. A screw projects through each side of the frame, and when one of the screws is driven home it urges the suspension against the two others. The three screws then hold it until the manipulation is completed.—Lond. *Elec.*, October 27; from *Ann. der Phys.*, No. 11.

Miscellaneous.

Death by Electric Shock.—Kratter and Jellinek.—Abstracts of two papers presented before the recent meeting of the German Naturalists in Meran. Kratter finds that death by electric shock is due to a kind of internal suffocation. The passage of 100 milliamperes through a human body is dangerous and often causes death. The seriousness of an accident depends on the resistance of the human body, which may vary between several hundred thousand ohms and a few thousand ohms. This variation of the resistance explains why men have been killed by little more than 100 volts, while others were not killed by several thousand volts. Jellinek described experiments which he had made with animals, and pointed out that an electric shock causes disturbances of vital functions which may be again revived. For this reason it seems probable that in many cases death by electric shock is only an apparent death. The importance of exact statistics of accidents due to electric shock was pointed out in the discussion.—*Elek. Zeit.*, November 2.

Annual Meeting of Westinghouse Managers.

The annual convention of the district managers of the Westinghouse Electric & Manufacturing Company was held November 13-16, at the general offices of the company at East Pittsburg. Mr. R. L. Warner, New England manager of the company, acted as chairman of the meetings, which were attended by the following representatives of the company: C. S. Powell, general agent, New York City; W. F. Zimmerman, representative, New York City; Maurice Coster, manager export department, New York City; W. C. Webster, assistant to second vice-president, New York City;

Group Portrait of Westinghouse District Managers.

F. H. Shepard, New York City; G. Pantaleoni, general southwestern manager, St. Louis, Mo.; J. R. Gordon, manager, Atlanta; H. H. Seabrook, manager, Baltimore; D. E. Manson, manager, Boston; C. W. Underwood, manager, Buffalo; T. P. Gaylord, manager, Chicago; C. W. Regester, manager, Cincinnati; G. B. Dusinberre, manager, Cleveland; J. E. Johnson, manager, Dallas; L. M. Cargo, manager, Denver; C. F. Medbury, manager, Detroit; T. J. McGill, manager, Minneapolis; C. A. Bragg, manager, Philadelphia; W. F. Fowler, manager, Pittsburg; D. E. Webster, manager, St. Louis;

W. W. Briggs, manager, San Francisco; M. P. Randolph, manager, Seattle; Paul T. Brady, manager, Syracuse.

At the opening session, which was held Monday morning, addresses were delivered by Mr. E. M. Herr, first vice-president of the company; by Mr. Frank H. Taylor, second vice-president, and by other officials. During the four days of the convention papers on topics of general interest were read by many of the officials and managers and by representatives of allied companies. On Wednesday evening the delegates and representatives of the local Westinghouse companies were entertained at the Hotel Schenley by Mr. Herr.

At no time in the history of the company have the managers spoken with more enthusiasm of the business conditions in their respective territories. Among these opinions expressed were the following: "I have it from the lips of a representative of one of the largest commercial interests in South America that the people in those countries would rather buy American machinery than buy European goods." This statement was made by the manager of the export department. Speaking further on the prospects for export business, Mr. Coster said: "The outlook for foreign trade has never been brighter in this country than at present. The superiority of American machinery as compared with European manufacture is being demonstrated every day, and in these markets where the Germans and English have heretofore enjoyed a monopoly, America is now gradually obtaining the lion's share of the business. As far as the Westinghouse Companies are concerned, we are enjoying the particular advantage that the name of Westinghouse is well known the world over: that our goods are used in every country on the globe, and hence we have no difficulty to obtain business for our companies."

Mr. F. H. Taylor, second vice-president, said: "I feel that this is a subject of congratulation, not only to ourselves, but also to the entire business interests of Pittsburg, that the prospects for prosperity in our works never will be brighter than at present. While we are already in possession of the facts which prove that the year of 1905 has been the banner business year in the history of the factory, we have every reason to believe from the assurances given us by our district managers from all over the country, who have now been in session here, that the industrial advancement throughout this country promises an unprecedented activity, and that our company will reap the benefit of this activity in a measure perfectly satisfactory to the company. I look for the business of 1906 to be materially larger than that of 1905."

Signal Service Annual Report.

Gen. A. W. Greely, chief signal officer of the army, in his annual report, advance copies of which have just been issued, says the Signal Corps can furnish all equipment necessary for 10,000 miles of communication. Studies of war in South Africa and Manchuria have shown deficiencies in the American army only in connection with the fire control of field artillery. Direct telegraphic communication is now established with five military posts in Alaska. The commercial business has netted $100,000 during the past year and, it is estimated, will be increased to $200,000 annually. The submarine cables of southeastern Alaska are 2,300 miles long.

Gen. Greely says the gradients of ocean depths were found most abrupt instead of gradual, as was indicated by existent soundings. Speaking of the wireless work in Alaska between Nome and St. Michael, Gen. Greely says: "This is the only wireless telegraph system in the world, it is believed, that is regularly operated as a part of a telegraph system handling commercial business. On August 6, 1904, it completed a year of uninterrupted service over its course of 107 miles. It has handled daily and uninterruptedly the entire telegraphic business of Nome and Seward Peninsula, which, together with the official business, averages several thousand words daily. More than a million words were sent during the year, many thousand being commercial code words in which no error has ever been traced to this section. In a single hour there have been transmitted over this section 2,000 words without error or repetition. Capt. Wildman was retained at Nome throughout an arctic winter to insure continuity of operation and the successful training of the enlisted force."

During the year there were 134,630 messages besides considerable free official business. Gen. Greely says: "It was deemed proper to relieve the isolation of Alaskan life by furnishing daily the approved news bulletin to each military post and station and by granting a strictly limited use of the line in intercommunication on social subjects between the different military stations."

Gen. Greely does not speak encouragingly of the detail system which he says he has loyally endeavored to carry out for the past three years. "As volunteers have failed conscription was necessary in the case of the sixteen officers already detailed (in the Signal Corps) of whom fully one-fourth have endeavored to evade service through personal or political influence," says Gen. Greely, and adds:

"It is suggested that the entire commissioned force of the army, excluding the permanent technical corps, be arranged in one lineal list below the grade of brigadier general. Through a system of annual retirement a suitable flow of promotion and elimination by retirement, as is done in the navy, of officers, incompetent, either morally or professionally, would then be practicable, and thus materially improve the service. Distinguished services could then be rewarded, without marked discrimination against equally competent officers who have not had opportunities, through advancement by files, the recipient being an extra number confirmed by the Senate."

Electrically Operated Capstan.

Among the interesting exhibits representing the Belgian industry at the Liege World's Fair may be mentioned the electrically-operated capstan shown by the Compagnie Internationale d'Electricite as indicated in the accompanying illustrations. Fig. 1 gives a general view of the exhibit, the foreground being occupied by the capstan and its magnetic controller. The capstan is separately shown in

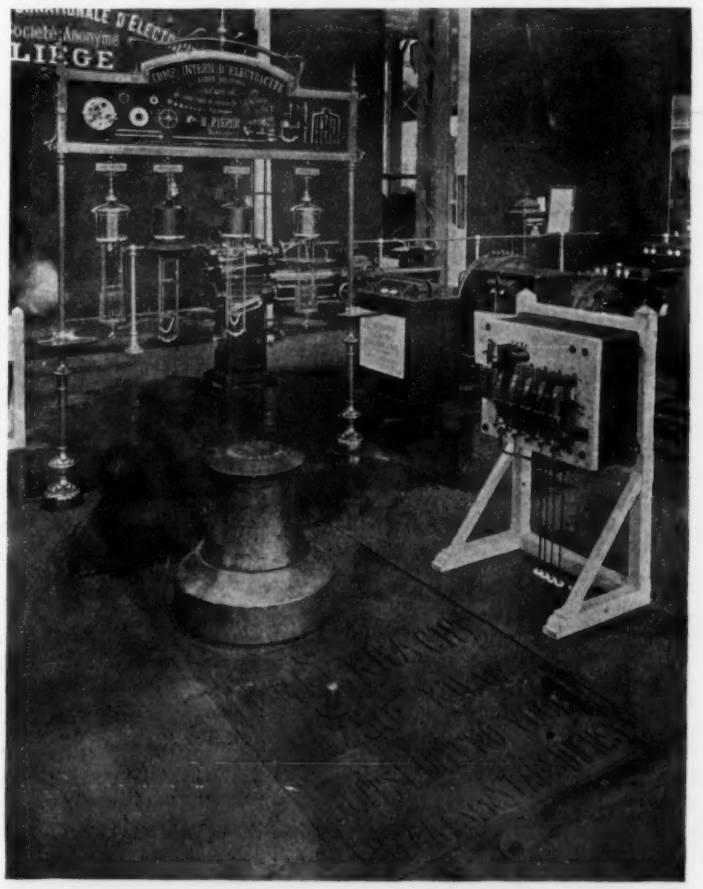


FIG. 1.—VIEW OF CAPSTAN AND CONTROLLER.

Fig. 2, from which it may be seen that the motor and gear transmission are properly balanced on an iron plate which is conveniently pivoted so that the lower part can be brought outside, and the machinery can be reached when necessary or desirable.

The controller, which is illustrated in Fig. 3, works automatically when the projecting rod shown in the floor plate, Fig. 1, is depressed by the foot of the operator. The five magnetic switches close suc-

cessively; the left-hand one closes the circuit through the controlling resistances which are then gradually short-circuited by the

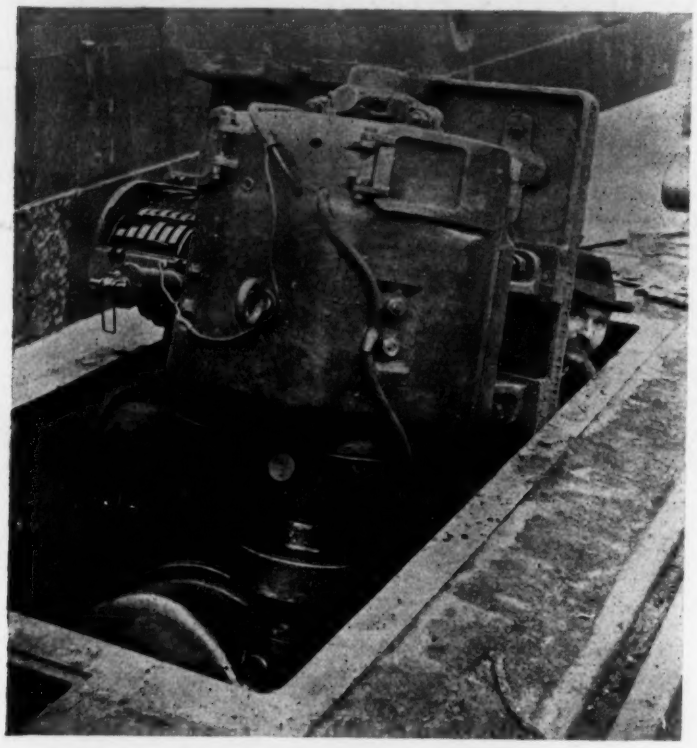


FIG. 2.—VIEW OF MOTOR FOR DRIVING THE CAPSTAN.

section switches which follow from left to right. An oil dash-pot serves for securing a proper speeding up of the capstan. A spring brings back the rod when the foot pressure is released. The stop-

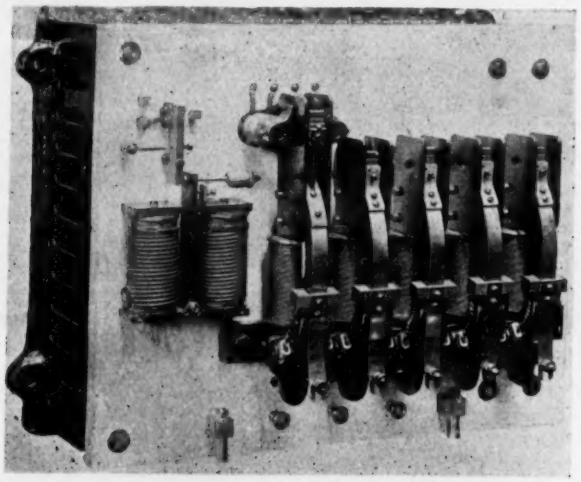


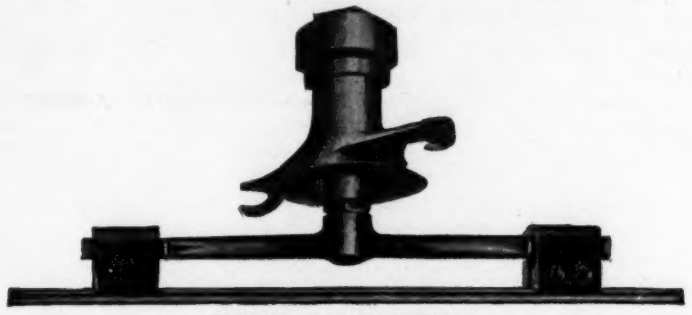
FIG. 3.—AUTOMATIC CONTROLLER FOR CAPSTAN MOTOR.

ping of the motor is greatly assisted by an electric braking effect, obtained by disconnecting the motor from the line and converting it into a generator which sends current through resistances so regulated that one-fifth of a turn is sufficient for stopping the capstan. The motor is provided with compound windings, for avoiding an excessive speed.

Flexible Suspension for Grooved Trolley Wire.

When trolley wires are rigidly suspended there is a tendency to break near the ends of the ear, owing to the continual and abrupt flexure of the wire at such points, caused by vibration of the free spans. This tendency is aggravated with soldered ears on account of the effect of the heat in impairing the mechanical strength of the wire locally. A device to overcome this trouble has recently been brought out in England by the British Thomson-Houston Company, and is known as the B. T.-H. patent flexible suspension ear.

The wire is held in mechanical clamps, so supported as to allow practically free movement in any direction without producing unnatural curves or abrupt bends, while preserving an even path for the trolley wheel and firmly supporting the wire in position. The upward movement of the wire and clamps, caused by the trolley wheel in passing under the ear, is practically parallel, and since the clamps are capable of a limited longitudinal displacement on the supporting bar, the wire takes up a natural curve without abnormal stresses in any part of its section. This form of suspension also



TROLLEY WIRE SUSPENSION.

obviates the objectionable hammer blow which takes place when the trolley wheel passes on to a suspension ear of the ordinary rigid type. These flexible ears are supplied either with a mild steel drop-forged body, with drop-forged clamps, or with a mild steel drop-forged galvanized body, with gun metal clamps.

Expanded Metal Lockers.

Although much thought has been devoted to rendering office buildings secure from exterior fires, little attention had been given to the possibility of fires starting within. The so-called fire-proof building is poorly made if filled with combustible wooden furnishings. It is in this connection that the great value and utility of steel equipment is shown. In order to meet the demand for fire-proof furnishings for office buildings, telephone exchanges and central stations the Edward Darby & Sons Company, of Philadelphia, has designed the Pen-Dar system of interior equipment, consisting of metal lockers, shelving, partitions, tables, etc., which are not only

EXPANDED METAL LOCKER.

absolutely fire-proof, but are sanitary, and add materially to the cleanliness, neatness and appearance of any building in which they may be placed.

The Pen-Dar expanded metal locker, shown in the accompanying illustration, is especially worthy of notice. The locker is built up of sheets of steel plate, which are cut, expanded and then rolled in such a manner that they present smooth surfaces, entirely free from rough edges or corners. This style of locker allows a free circulation of air, and, therefore, is thoroughly ventilated. Each locker is equipped with one shelf, three nickel-plated coat hooks, individual brass number plates, and special three-point locking device, which securely fastens the door at the top, center and bottom with a single turn of the locking lever.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The industrial and commercial situation continues very satisfactory. Reports indicate a further increase on the volume of business, and orders are being received for distant delivery, while buyers experience much difficulty in making purchases for prompt shipment. The approaching holiday trade, coupled with the colder weather, has caused heavy distribution in practically every section of the country except in the Northwest, where unseasonably high temperatures prevail and where the railway congestion prevents fullest development of trade. Railway earnings are very heavy, but the widespread blockades are assuming a serious phase and tend to curtail production in some industrial lines. The earnings for the first week in November were 4.9 per cent larger than they were in the corresponding period last year. All manufacturing lines keep up their high record of activity, the only discordant note being scarcity of labor in a few instances. The consumption of iron and steel goes on at a high rate with every indication of its continuance, and outdoor construction is being conducted on an extraordinary scale. Collections on the whole are classed as good, and the demand for money is generally increasing. Some raw materials, cotton and some grades of wool have lost strength, but this does not detract from the activity in nearly all manufacturing lines. Cotton is being held at the South for higher prices, and in that section the financial and industrial conditions are more satisfactory than they have been for years. In the great basic industries a further hardening of pig iron is noticeable. Plate mills are full of business and premiums for early delivery are the rule. Contracts for over 100,000 tons of steel rails were awarded during the week. Railway car builders are active, and lumber, hardware and builders' materials are in heavy demand. Copper has advanced in price. Lake closed at 16 3/16c., electrolytic 6¾c. and casting stock 6½. *Bradstreet's* reports 198 failures in the United States for the week, against 166 the previous week, and 190 for the corresponding week of 1904. The Middle States had 72, New England 33, Southern 30, Western 32, Northwestern 13, Pacific 10 and Territories 8. About 90 per cent of the total number of concerns failing had capital of $5,000 or less and 6 per cent had between $5,000 and $20,000 capital.

POWER FOR LOS ANGELES, CAL.—Mr. A. K. Detwiler, former Toledo capitalist, but now a resident of California, is interested in a corporation being formed for the purpose of erecting a power plant ninety miles from Los Angeles. Mr. Detwiler is heavily interested in telephone and electric properties in the Golden State, and is now giving his whole time to their development. The Express of Los Angeles says: "Besides entering the field as a producer of electricity the proposed company will also build dams and lay pipes for the distribution of 7,500 in. of water to certain points. Mojave River Valley will be the chief scene of the new corporation's operations. A. E. Poole, of Los Angeles, who has been at work quietly upon the project for many months, has secured the agreement of Philadelphia and Ohio capitalists to an organization for the purposes named, and incorporation papers will be filed within a short time. Mr. Poole says that his company already has secured all riparian rights to cover a watershed in the San Bernardino range and connecting lands amounting to 400 square miles. In order to develop the water and latent power a huge dam is to be constructed at Victor Narrows, which forms an immense natural reservoir. At that place will be constructed a plant which will develop 15,000 hp in electricity. It will cost in the neighborhood of $800,000 and will be completed within two years." The cost is estimated at a total of $6,000,000.

AN INDUSTRIAL ENGINEERING DEPARTMENT.—The Crocker-Wheeler Co. announces the establishment of an industrial engineering department, in which is concentrated all its work in the line of industrial engineering as applied to railway shops, machine shops, and industrial plants of every description. The company were among the first manufacturers to recognize that even high-class electric motors and generators should be accompanied in every case with sound engineering advice to the purchaser. Each sale of a motor has meant with it that a motor-drive problem has been successfully solved by a group of engineering experts. The company is not only "manufacturer" but "electrical engineer." Among those who have availed themselves of the services of Crocker-Wheeler Co. in this line are the Lake Shore & Michigan Southern Rd., John Simmons Co., Bucyrus Co., Ansonia Brass & Copper Co., American Bridge Co., Pittsburg & Lake Erie R. R., Joseph Dixon Crucible Co., Ingersoll-Sergeant Drill Co., etc. Mr. J. K. Warner Davenport, E. E., formerly a consulting engineer making a specialty of industrial work, has become associated with the company in order that its growing activities along these lines may be handled in as thorough and satisfactory manner as heretofore. Mr. Davenport and his staff of assistants are at the present time giving personal attention to several important industrial propositions.

PORTLAND GENERAL ELECTRIC.—H. W. Goode, president of the Portland General Electric Company, has left for New York and various Eastern manufacturing centers to arrange for the purchase and shipment of a complete new lighting apparatus, which is to be installed in Portland without delay. Mr. Goode says that the Portland General Electric Company will have work on the new system under way by January 1 and should have it completed by July 1. Under the new system Portland will have metropolitan street lights throughout the city. Every one of the 1,200 carbon arc lights will be replaced by magnetite arc lights. The cost of installing the new system, Mr. Goode stated, would be about $100,000. It will necessitate new apparatus in the sub-station at Seventh and Alder Streets, and require the rearrangement of the company's entire system.

BELL TELEPHONE OUTFIT.—The following is the Bell telephone instrument statement for October:

	1905.	1904.	1903.	1902.
Gross output	193,272	113,760	111,749	92,601
Returned	60.073	50,772	49,885	37,155
Net output	133,199	62,988	61,864	55,446
Since December 31:				
Gross output	1,494,330	990,369	923,978	900,935
Returned	517,478	425,697	408,716	383,844
Net output	976,852	564,672	515,262	517,091
Total outstanding	5,457,416	4,344,189	3,665,582	3,042,697

This would indicate 2,728,708 sets outstanding, or, roughly, 2,500,000 subscribers. The October gain is the largest in the year, and the increase during the year to October 31 is no less than 1,113,227 instruments.

MONARCH ELECTRICAL & MANUFACTURING COMPANY.—Messrs. K. E. Pew, of Warren, and J. F. Bonnell, of Youngstown, have, according to local prints, purchased 100 of the 130 shares of stock in the Monarch Electrical & Manufacturing Company, of Warren, O., and will continue the business of the company under the same name, and at the same location. The capital stock of the company will not be increased, but the company expects to enlarge its business and manufacture the old line of Monarch lamps, but will give its attention principally to the Monarch burst cluster. Employment will be given to a number of hands. The company will reorganize immediately and Mr. K. E. Pew will be elected as general manager.

ENGINEERING IN MEXICO.—The Federal Engineering & Construction Co., of Mexico City, has become the Federal Engineering Company. The capital is $25,000, gold, and the new concern will handle the construction work on all kinds of large engineering enterprises. It will also do general consulting work, giving special attention to hydro-electric development. The company has already been awarded several contracts, one being for $75,000 of material for the new aqueduct which is to supply water to Mexico City. The officers are Epes Randolph, president; A. H. McKay, vice-president; Milton T. Thompson, general manager, and Andres Horcasitas, secretary. The address is San Juan de Letran, No. 3.

CHICAGO ELEVATED ROADS.—The Chicago Northwestern Elevated is in the market for 8,000 tons of structural steel for its Ravenswood extension. Northwestern Elevated traffic this month will show an increase of 8 to 10 per cent. Since the first of November the Chicago Metropolitan Elevated has carried on an average of about 135,000 passengers as compared with 115,000 daily during November, 1904. The Beach Amusement Park, when opened, will add from 10,000 to 15,000 fares daily.

OCTOBER TRADE.—The Bureau of Statistics reports the foreign trade for October, showing exports of $154,398,872 and imports of $107,518,065, or an excess of exports of $46,880,806. The exports are the largest for this year, and the imports are the heaviest on record, except those of last March. The total exports for ten months are $1,256,950,246, and the total imports $979,987,820. The exports are slightly below those of October, 1904 and 1903.

HIGHER PRICE FOR BELTING.—An increase of 10 per cent in the price of leather belting has been decided upon by the National Leather Belt Association, which is composed of the leading belting manufacturers of the country. Since the introduction of automobiles, the demand for leather has greatly increased. In addition to this, it is said the raw material costs more now than ever before.

STANLEY FACTORIES. It is stated from Pittsfield, Mass., that the Stanley Electric Manufacturing Company has secured options on several pieces of property in the vicinity of the Beaver Street shops. It is probable that the company will fill up all their land with saw tooth buildings or possibly with one or more big shops.

NAVAL ARCHITECTS AT SCHENECTADY.—Following the general convention of the Society of Naval Architects and Marine Engineers, held in New York Thursday and Friday of last week, guests to the number of 135 boarded a special train at the Grand Central Station early Saturday morning for Schenectady. The special train on arrival at Schenectady was switched into the yards of the General Electric Company where breakfast was served on the train. The visitors were then escorted in groups through the works in charge of representatives of the company. For the information of the visitors, a pamphlet was distributed which illustrated the marine section of the company's products and works, including a diagram of the route of inspection. The morning was spent in inspecting the various shops, including those devoted to the manufacture and test of the Curtis steam turbines which were of special interest to the visitors, as were the searchlight projectors and other applications of electricity to marine service. The society members of the General Electric Company were in charge of the trip and the entire matter was handled by Mr. J. W. Kellogg, head of the Marine Department of the company. After the morning spent in the works, the train was again delivered to the New York Central and the guests returned to New York City in the afternoon.

Financial Intelligence.

THE WEEK IN WALL STREET.—With the decline of money rates the prices of stocks recovered, although there was considerable depression and liquidation in the early part of the week. Bullish manipulation of both industrial and railroad specialties had the effect of causing a rally in prices. The United States Steel stocks sold off with the general list at first, and, although they recovered later on, were not especially prominent. The local traction issues continued heavy on the uncertainty of the political situation in New York City, but were not the objects of any particular pressure. The electric securities with the rest of the market showed more firmness and scored advances. Allis-Chalmers common made a net gain of 1⅜ and preferred ⅞, the closing quotations being 20⅜ and 62⅛, respectively. On aggregate sales of 5,200 shares General Electric advanced from 181½ to 186, and closed at 185½, which is a net gain of ½ point, Westinghouse common closed at the highest figure of the week—172—this being an advance of 2 points; preferred, however, last 7 points, closing at 190. American Locomotive common ranged between 64 and 60¼, and closed at 67¾, which is a net gain of 1½ points, while preferred lost ½ point, closing at 114. Among the traction list Brooklyn Rapid Transit gained 7 points, closing at the highest figure—81¾. The sales of this stock aggregated 346,800 shares. Metropolitan Street Railway touched 118⅛ during the week, but receded and closed at 116⅛. Interborough Rapid Transit made a net gain of 3⅛ points, closing at 212. Western Union closed at 92⅞, a decline of ⅛-point. The curb market developed considerable strength in sympathy with the Stock Exchange list. The features were Chicago Subway, Interborough and the Copper shares. The closing quotations on the Stock Exchange November 21 are as given herewith.

NEW YORK

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
Allis-Chalmers Co	20	20⅜	General Electric	182	187¾
Allis-Chalmers Co. pfd	62⅜	62⅜	Hudson River Tel.	..	..
American Dist. Tel	37	37	Interborough Rap. Tran	207	212
American Locomotive	67⅜	69¼	Mackay Cos.	48⅛	50⅜
American Locomotive pfd	114	117⅜	Mackay Cos. pfd.	72	72¼
American Tel. & Cable	93	91	Marconi Tel.	..	..
American Tel. & Tel.	133	134	Metropolitan St. Ry.	117⅛	116⅞
Brooklyn Rapid Transit	76¼	87⅛	N. Y. & N. J. Tel.	..	..
Electric Boat	32	32	Western Union Tel.	92⅞	92⅜
Electric Boat pfd	70	70	Westinghouse com.	175	169
Electric Vehicle	15	14	Westinghouse pfd.	..	..
Electric Vehicle pfd	20	20			

BOSTON

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
American Tel. & Tel	134	135⅛	Mass. Elec. Ry. pfd.	56	56
Cumberland Telephone	122¼	122½	Mexican Telephone	1⅝	1⅝
Edison Elec. Illum	245	*246	New England Telephone	134	134½
General Electric	182	186	Western Tel. & Tel.	13	13
Mass. Elec. Ry.	13¼	13	Western Tel. & Tel. pfd	89	90¼

PHILADELPHIA

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
American Railways	53	53	Phila. Electric	8⅜	8⅜
Elec. Co. of America	11⅝	11⅜	Phila. Rapid Trans.	30¾	31¼
Elec. Storage Battery	78	81	Phila. Traction	..	..
Elec. Storage Battery pfd	..	..			

CHICAGO

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
Chicago City Ry	200	200	National Carbon	60	69
Chicago Edison	..	..	National Carbon pfd	115	114
Chicago Subway	..	..	Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd	..	..
Metropolitan Elev. com	28⅛	27			

* Asked.

ANNUAL REPORT OF BOSTON & WORCESTER.—The annual report of the Boston & Worcester Street Railway Company for the year ended September 30, 1905, showed that the company earned 6 per cent upon its capital stock after allowing liberal charges for taking care of its track, roadway and equipment. The company is planning to complete the double-tracking of its line through Framingham Center in the spring at a cost of approximately $150,000, and then the road will be double-tracked the entire distance between Boston and Worcester. The management of the Boston & Worcester Company anticipates, that, with the completion of the double-tracking, the gross earnings for the first full year after such completion will reach $600,000 without taking into consideration any earnings from the express and parcel business. For the fiscal year ended September 30, 1905, the company's lines carried 9,110,000 passengers, as compared with 8,000,000 the previous year, and its cars ran 1,820,575 car miles, as compared with 1,793,163 car miles the previous year.

ALBANY TROLLEY PURCHASE.—It is stated from Albany that the United Traction Company, controlling the street car system of Albany, Troy, Rensselaer and Cohoes, is to be sold to a purchaser, who, it is understood, represents the Delaware & Hudson interests. The sale was announced after a protracted meeting of the directors of the United Traction Company, as the result of two years' negotiations, in which Anthony N. Brady represented the stockholders of the company. A circular issued to the stockholders announces that the sale is to be made at $150 a share, available for all stockholders who shall deposit their stock before November 28 with the National Commercial Bank of Albany and that it is conditional upon the surrender of at least 51 per cent of the entire outstanding capital stock before that date. Rumors have been current for months that the New York Central interests were after this system, but is is stated on high authority that the Central is not concerned in this purchase. A price of $150 a share represents a total purchase of $7,500,000 for the stock.

DIVIDENDS.—The directors of the Washington Railway & Electric Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable December 1. The directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent, payable December 15. The regular quarterly dividend of 2 per cent has been declared on the stock of the Kings County Electric Light & Power Company, payable December 1. The directors of the American Graphophone Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable December 14. Directors of the Rochester (N. Y.) Railway & Light Company have declared a dividend of 1 per cent on the preferred stock payable December 3. Directors of the Kansas City Railway & Light Company have declared the regular quarterly preferred dividend of 1¼ per cent, payable December 1. The Philadelphia Electric Company has declared a regular semi-annual dividend of 2½ per cent., payable December 15.

THE PHILADELPHIA CO.—It is said that a new holding company will be formed to purchase control of the Philadelphia Company. For each $50 share of common stock of the Philadelphia Company the new company will offer $37.50 in collateral trust bonds secured on Philadelphia Company stock, and $20 in common stock of the new company. The new company will also guarantee to pay after three years $90 per share for the new stock, making $18 per share for the amount of new stock received by each share of the Philadelphia Company common. The Philadelphia bonds and capital stock aggregate about $55,000,000.

NEW YORK SUBWAY.—The quarterly report of the Interborough Rapid Transit Company shows a deficit of $117,741 for the elevated roads for the three months ended September 30. The surplus for the Subway was $227,560, so that the quarter's surplus from the operation of both divisions amounted to $109,820. This compares with a surplus of $411,310 on September 30, 1904, nearly two months before the Subway was opened. Gross earnings of the Interborough Company for the quarter were $3,905,097, an increase of $672,148 over the corresponding period last year. Operating expenses increased $598,352.

PITTSBURGH TELEPHONE.—The Central Dispatch & Printing Telegraph Company announces that 10,000 shares of treasury stock, with a par value of $1,000,000, is offered to stockholders at par (100). The company is capitalized at $15,000,000, and $10,000,000 is outstanding. Stockholders of record November 29 will have a right to subscribe for the new stock on a basis of one share of new stock for every ten shares of the old held. The right to subscribe expires January 18, 1906, and payment must be made on or before January 31, 1906.

General News of the Week

The Telephone.

SEARCHLIGHT, CAL.—A. M. Joy is here for the purpose of installing a local telephone exchange, reaching all the mines in the vicinity of Searchlight, and a long-distance line between this place and Nippeno.

SAN FRANCISCO, CAL.—The Standard Electrical Construction Company, of this city, has contracted to install a complete central energy telephone system for the Del Monte Hotel at Monterey, Cal., and to re-wire the main hotel building for about 5,000 lights. It has been decided to abandon the plans for installing an isolated electric power plant, and power will be purchased from the local electric lighting and street railway company. About 400 telephones will be installed about the hotel and grounds. The central energy switchboard, telephones, etc., with flash signals, will be supplied by the De Veau Telephone Manufacturing Company, of New York.

NORWICH, CONN.—The Southern New England Telephone Company is having plans made by L. W. Robinson, of New Haven, for a new building to be erected in Norwich.

MERIDEN, CONN.—The Southern New England Telephone Company is making extensive improvements in its service throughout Connecticut. New switchboards are being installed in New London, Stamford and South Norwalk. Many private branch exchanges are also being installed in the principal hotels throughout the State.

HARTFORD, CONN.—Application has been made for a charter for the Citizens' Telephone Company of this city. This is an independent company and will have a capitalization of $1,000,000, with the privilege of increasing this to $10,000,000 as necessary. Mr. D. A. Reynolds of the State Line Telephone Company, of New York City, is one of the leading promoters in the enterprise.

WEST PALM BEACH, FLA.—Dr. Liddy, of this city, and associates will apply for a franchise to construct and operate a telephone system.

BURLINGTON, IA.—The city council has voted to allow the Iowa Telephone Company to place its wires underground.

VIENNA, ILL.—The capital stock of the Interior Telephone Company of Vienna has been increased from $300 to $50,000.

SPRING VALLEY, ILL.—The Spring Valley Telephone Company has been incorporated with a capital stock of $10,000, by E. M. Bayscar, S. H. Brakel and Charles W. Knapp.

MULBERRY GROVE, ILL.—The Mutual Telephone System has been organized here with a capital stock of $2,500. The incorporators are: D. W. Brunson, J. S. Jones and L. Bosberne.

MONTICELLO, IND.—The Monticello Telephone Company has made a deal with the Bell Telephone Company for toll connections. All Bell telephone lines will come in over the local company's switch, and all Bell telephone booths in the town will be removed and long-distance transmitters and receivers will be installed when desired.

INDIANAPOLIS, IND.—At a meeting of the directors of the New Long Distance and the Indianapolis Telephone companies, both of which have recently changed hands, it was decided to expend all the money necessary to better the local switchboard facilities and provide for furnishing telephones immediately to those who apply for them. The local service has been handicapped in this particular, and it is the intention of the new management to see that everything necessary is done to make the service all that could be asked.

AUGUSTA, MICH.—The Citizens' Telephone Company has opened an exchange at Augusta, using the automatic system.

SAULT STE. MARIE, MICH.—Local business men have started a movement to organize an independent telephone company to fight the Michigan State Telephone Company. A raise of rates from $18 to $24 by the Michigan company is the cause.

CADILLAC, MICH.—The organization of the Wexford County Independent Telephone Company has been completed. The company is capitalized at $1,000 and expects to increase the capitalization to $5,000. The officers are: President, G. A. Lake; vice-president, A. B. Southick; secretary, D. L. Rose; treasurer, R. D. Fredrick.

DETROIT, MICH.—The executive committee of the Municipal League has passed a resolution to the effect that in its opinion a second telephone system is not needed in this city; that one company with the highest grade service and reasonable rates is the ideal; that to establish a second telephone service as a protective measure against possible future bad service and extortionate charges of the one company is at this time unnecessary; that such a company can be established when the necessity arises and it is found that such second company will be the only remedy.

PORTLAND, ME.—The South Porto Rico Telephone Company has been formed here with a capital stock of $30,000. The officers are H. L. Cram, president; A. F. Pine, treasurer, and C. D. Booth, clerk, all of Portland.

STARBUCK, MINN.—The White Bear Lake Telephone Company will establish an exchange in this place.

COLOGNE, MINN.—The Norwood Young America Telephone Company has installed an exchange here.

PINE CITY, MINN.—The Northwestern Telephone Exchange Company has been granted a franchise for a local exchange.

GLENWOOD, MINN.—The Glenwood Telephone Company, with a capital of $12,000, has been incorporated by H. A. Wollan, C. T. Wollan, P. Peterson, C. C. Wollan and H. D. Peterson.

ST. JAMES, MINN.—The officers and directors of the St. James Telephone Company have purchased the local exchange from the Southwestern Minnesota Telephone Company, the price paid being $9,000.

BROWNING, MO.—The Browning Telephone Company has been incorporated and the following named officers elected: President, H. C. Taggart, Linneus; vice-president, J. C. Green, Browning; secretary, A. C. Hutchinson, Purdin; treasurer, H. T. Young, Purdin.

TRENTON, N. J.—A committee of directors of the Interstate Telephone Company has been appointed to readjust the affairs of the corporation because of the default of interest on the company's bonds last July. The committee was empowered as a voting trust to secure an adjustment of the company's affairs on an 80 per cent. basis.

BATH, N. Y.—The Bradford Telephone Company has been incorporated with a capital stock of $2,000. The directors are: Theodore W. Chase, of Bath; F. G. Ovenshire, of Urbana, and Edgar Sanford, of Bradford.

SYRACUSE, N. Y.—The franchise offered by the Inter-Oceanic Telephone Company of Buffalo, asking permission to construct a conduit system and plant poles, in connection with the establishment of an exchange in this city, has been rejected by the common council.

ROXBORO, N. C.—The Morris Telephone Company of this city has been incorporated, with a capital stock of $100,000.

CARRINGTON, N. D.—The North Dakota Telephone Company, with a capital of $50,000, has been incorporated.

ELK CITY, OKLA.—The United Telephone & Telegraph Company, of Elk City, has been incorporated with a capital stock of $100,000. The following named gentlemen are directors: C. T. Patterson, M. T. Spurlock, M. Scannell, W. T. Patterson and E. M. Scannell.

NEW BEDFORD, PA.—Residents of New Bedford have held a meeting for the purpose of organizing an independent telephone company to affiliate with what is known as the Citizens' Company, doing business in Sharon, New Castle and other Pennsylvania cities.

PITTSBURG, PA.—The Central District & Printing Telegraph Company has secured control of the Farmers' Telephone Exchange, of Lowell, O., and the franchise of the Murraysville Telephone Company at Export, Pa. The deals will give Pittsburg connection with new territory. The Lowell Company covers five townships in Washington County, O., and has 180 subscribers on its list. The Murraysville Telephone Company is located in Westmoreland County and the line is now being built. The company has 140 subscribers, most of whom are farmers.

PHILADELPHIA, PA.—The Bell Telephone Company, of this city, and the American Telegraph & Telephone Company, of New York, are placing 75,000 miles of wire underground between Wilmington and New York. The cost is estimated at $2,500,000, and more than 1,500 men are at work. It is proposed to have 50,000 miles of wire in operation before the end of the year. Eight ducts, carrying a large cable, are to be placed underground between this city and New Brunswick. A similar number are being laid to Wilmington. It has been planned to have two trunk lines between this city and New York as soon as possible.

SPRINGFIELD, TENN.—This place is now in the throes of a very hot telephone war. The Cumberland people and the Home or independent, are both circulating petitions, the former asking the people to say that one telephone was all that was wanted, and that two would be a nuisance, while the latter is asking the people to sign it because it would be far-reaching and give better service and lower rates. The Home wants to come here and put in an exchange and will put up its own building, and proposes to spend thousands of dollars in Springfield and this county and nearly all the business people here signed their petition. There is now no doubt that Springfield will in the next few weeks have the two systems in operation.

BLOOMING GROVE, TEX.—The Blooming Grove Telephone Company has been incorporated with $5,000 capital stock, by J. H. Jones and others.

BRONTE, TEX.—The Dixie Telephone Company, of Bronte, Cooke county, has been formed; capital stock $10,000. The incorporators are: B. H. Rand, Bascom Lynn and D. A. Lynn.

SPOKANE, WASH.—The Commercial Club at Lewiston and Clarkston favors the proposal made by the Pacific States Telephone Company to improve its service, and the independent company, which had 1,000 subscribers pledged, will retire from the field.

PULLMAN, W. VA.—The Washburn Telephone Company has been incorporated with a capital stock of $20,000 by J. O. Nay, Pullman; J. H. Lininger, W. R. Heservie, Okey E. Butter and A. J. Wilson, Harrisville, W. Va.

GREEN BAY, WIS.—The Brown County Telephone Company has been formed with a capital of $10,000. The incorporators are: Henry F. Hagemeister, C. A. Straubel and Frank J. B. Duchateau.

KENOSHA, WIS.—The Kenosha Home Telephone Company, with capital of $175,000, has been incorporated by Alonzo Burt, Milwaukee; Jas. Cavanaugh, Frank Slosson, Kenosha. The new company is to take over the plants of the Wisconsin and Citizens' Telephone Company and will unite the two.

MILWAUKEE, WIS.—The Milwaukee Retail Druggists Association has voted against the proposal of the Wisconsin Telephone Company to make a contract for its entire membership, giving the Wisconsin Telephone Company the exclusive right to install telephones in their places of business for five years.

Electric Light and Power.

PRESCOTT, ARIZ.—The McCabe Water, Light and Power Company has been incorporated with a capital of $50,000. The incorporators are H. A. Suttle and Hiram E. Todd, of Peoria, Ill. Place of business, Prescott.

JACKSON, CAL.—Geo. C. Bruce and F. H. Harding have located 20,000 miners' inches of water on the north fork of the Bokelumne River for electric power purposes.

RIO VISTA, CAL.—J. S. McDonald, representing the Rio Vista Electric Light and Power Company has been granted the privilege of erecting poles on the streets and a lease on certain town property on which he wishes to build a power plant.

SAN DIEGO, CAL.—For the purpose of developing electric power the Fletcher-Salmons Investment Company has filed upon 25,000 miner's inches of water near the head of the San Luis Rey river, and upon 20,000 inches near the head of Pauma Creek. Deeds to the same company convey 1,300 to 1,400 acres of land at South Oceanside and Carlsbad.

SAN BERNARDINO, CAL.—The Lytle Creek Power Company has been awarded the contract for lighting this city for the next five years. The company will immediately commence the erection of a power plant in Lytle Creek Canyon, and the building of a pole line to this city will commence at once. A franchise has already been secured.

SAN FRANCISCO, CAL.—The Redwood Manufacturers' Company, which is doubling the capacity of the electric power house supplying power for operating its factories at Black Diamond, Cal., has closed a contract with the National Electric Company for a 250-kw, 3-phase, 500-volt generator. A Hamilton-Corliss engine, supplied through Chas. C. Moore & Co., will be direct-connected to generator.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation has made a great deal of progress on the gas-engine reserve plant at the corner of Walbridge and Schwerin Streets, but will not have the electric generating units ready for operation before February, owing to a delay in the completion of some parts of the engines. The frequency changers will be installed in time so that electric power can be furnished for the operation of the United Railroads cars in the city under the contract beginning Jan. 1, 1906. One of the three units will be kept in operation all the time, and in case of any interruption of the current on the water-power transmission lines which furnish the main supply of power, the other gas engines will be started up. The new plant can also be depended upon to "boost up" the transmission lines when there is a shortage of power from lack of water or other causes. Wharves and other improvements have been put in on the Bay shore, opposite the plant, to facilitate the handling of supplies and materials. The gas works power house and equipment will cost about $1,000,000.

YALESVILLE, CONN.—A committee has been appointed to act on the proposed electric lighting of the village.

THOMASTON, CONN.—It is reported that the railroad company has bought the Thomaston plant on Electric Ave., or at least has secured a controlling interest. The company intends to use it in connection with the trolley road.

ENFIELD, CONN.—The Enfield Gas Company has purchased the plant of the Windsor Locks Electric Light Company. It is stated to be the purpose of the company to use the present water power for the generation of electric power and install gas engines for furnishing such additional electric power as is wanted.

COLUMBUS, GA.—The lighting committee of the Council will investigate the cost of a municipal lighting plant.

ATLANTA, GA.—The Southern Light & Power Company has petitioned Council for a franchise. It will get its power from the plant of the North Georgia Electric Company, at Gainesville, and transmit it to Atlanta.

GALESBURG, ILL.—The People's Electric Power Company has been incorporated with a capital stock of $2,500. The incorporators are Charles S. Harris, Addison P. Higgins and Frank W. Harris.

BLOOMINGTON, ILL.—The Union Gas & Electric Company of Bloomington has increased its capital stock from $400,000 to $750,000.

STREATOR, ILL.—The People's Light & Railway Company and the Streator Gas & Light Company, two large local corporations, have been combined, the recently incorporated Illinois Light & Traction Company being the purchaser. The latter corporation is capitalized at $400,000, and, in addition to extending the local lines will build an interurban road connecting Streator and Ottawa. Negotiations are pending for the purchase of the street railway plants and the lighting plant at Ottawa.

TERRE HAUTE, IND.—The result of the recent municipal election has prompted the city authorities to take steps to build a new municipal electric light plant. Alvin M. Higgins is president of the Board of Public Works.

FORT WAYNE, IND.—The Fort Wayne Electric Works have recently shipped a 100-light generator to the California Polytechnical School at San Luis Obispo, Cal., and two 60-light generators to Pittsfield, Mass.

ZIONSVILLE, IND.—Zionsville Water & Electric Light Company will construct an electric light plant and will be in the market for the entire equipment excepting for power.

LINDSAY, I. T.—A series of falls in the Washita River have been examined by experts who pronounce them of sufficient capacity for the development of electric power. The matter will be taken up at the next meeting of the city council.

AFTON, IA.—The citizens have voted to issue bonds for the construction of an electric light plant.

LINCOLN CENTER, KAN.—It is proposed to construct an electric light plant and water works at a cost of $34,500. No engineer has been selected as yet. Address, the Water Works Committee, Lincoln, Kan.

PORTLAND, ME.—The Portland Lighting & Power Company is making an important addition to its plant at Deering.

WINCHESTER, MASS.—The Edison Electric Illuminating Company has lately taken over the business of lighting the streets and houses of Winchester, which service was formerly performed by the Woburn Light, Heat & Power Company.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has petitioned the State Board of Electric Light & Gas Commissioners for permission to increase its capital stock from $50,000 to $80,000, for the purpose of making extensive repairs at the plant in this place.

LENOX, MASS.—It is stated that the State gas and electric light commission is to be asked to investigate the Lenox Electric Light Company's charges for light and power. For several years complaint has been heard against the rates made by the company to consumers.

NEW BEDFORD, MASS.—A petition, circulated by the Board of Trade among the largest local consumers of gas and electricity, asking the gas and electric light commission to investigate the affairs of the New Bedford Gas & Electric Light Company, with a view to securing a reduction in rates, has been presented to the commission. The board has granted a hearing, which will be held in this city.

FAIRVIEW, MICH.—Village Trustee Matt Kramer is interested in the construction of an electric light plant.

HOUGHTON, MICH.—The Superior Construction Company, of Houghton, has been awarded the contract for the construction of the municipal lighting and power plant at L'Anse.

MARSHALL, MICH.—The Gas & Electric Development Company, of Philadelphia and New York, reports the sale of the plant at Marshall, Mich., to Mr. Carroll Collins, who has already assumed control.

ANN ARBOR, MICH.—The Detroit Edison Company has purchased three dam sites on the Huron river for $130,000. An immense dam will be built at Geddy's for the generation of electric power for use in the valley and in Detroit.

LANSING, MICH.—The Commonwealth Power Company, of Jackson, has purchased a site for a sub-station in the city. The company will furnish power for the Lansing-Jackson electric railway, the Lansing-St. Johns railway and the Lansing-Haslett Park line.

TRAVERSE CITY, MICH.—The City Council has closed a contract with the Boardman River Electric Light and Power Company for lighting the city for another year on an all-night schedule except for shut-downs after midnight for repairs, at a cost to the city of $60 per light. The contract runs for five years and provides for 100 lamps.

BELLE PLAINE, MINN.—Bids are wanted until Nov. 27 for an electric light plant on which a 20-year franchise will be given; bids to state price of 16 street arc lights of 1,600 to 2,000 candle-power per month, and cost of each additional light; also cost of incandescent lights for commercial use. J. E. Townsend is borough clerk.

NEW ALBANY, MISS.—The Board of Aldermen of this city will probably issue $12,000 of town bonds, the proceeds of which will be expended in enlarging the city electric light plant and in other municipal work.

BOWLING GREEN, MO.—The Pike County Light & Power Company has been incorporated, with a capital of $7,000 by H. Ladford and I. Dempsey.

INDEPENDENCE, MO.—The City Council has granted a franchise to the General Light, Heat & Power Company, subject to the approval of the citizens.

FREMONT, NEB.—About $5,000 will be expended for improvements to the electric light plant. J. H. Mathews is superintendent.

RENO, NEV.—It is stated that a movement is on foot to form a company to install an electric lighting plant on the Truckee River, a short distance below Vista, where Henry Riter, W. G. Caffrey, Capt. Mills, R. K. Brown and H. B. Corey, of Boston, own a 40-acre tract of land, which is to be used as a site for the plant.

RENO, NEV.—Judge Turner and A. A. Hibbard, who recently acquired options on extensive water rights on the head waters of Walker River in Mono County, Cal., and Joseph A. Brown, treasurer of Mono County, are said to be interested in a power deal, with Tonopah as its ultimate market.

GOLDFIELD, NEV.—The California and Nevada Mining & Mill Company proposes to erect an electric power and light plant at Big Pine, Cal., for use in Goldfield, Lida, the Bonnie Clare mine, the mines of the Bullfrog district, as well as the towns of Rhyolite, Bullfrog and Beatty. The company is incorporated under the laws of Arizona, with a capitalization of $5,000,000. It claims to have 1,000 miners' inches of water at Big Pine, with a fall of several thousand feet in eight miles, and proposes to generate 6,000 hp.

VERDI, NEV.—The generating station built this year at Marmol, a few miles above here, for the purpose of furnishing electric power to run the Comstock mines, is practically completed. The station is the property of the Truckee River General Electric Company, behind which are the Fleishackers, who also own the Floriston Pulp and Paper Mill; the electric plant at that place; the electric plant at Laughton, six miles above Reno, and the plant at Reno—the four largest in Nevada. The Fleishackers now own the most valuable power sites on the Truckee River and have a complete monopoly on the lighting and power situation in western Nevada, supplying all that is used by Reno, Sparks, Verdi, Carson, Virginia, Silver City, Dayton and the other small towns in these vicinities.

EXETER, N. H.—Mr. William H. C. Follansby, of Exeter, has been appointed receiver of the Newmarket Electric Light, Heating & Power Company. A minority of the stockholders allege that the company is mismanged and that stock and bonds have been fraudulently issued.

WASHINGTON, N. J.—Chester Snyder and others, of Easton, have purchased the plant of the Washington Electric Light Company and will expend about $10,000 in improvements.

PERTH AMBOY, N. J.—C. D. Boynton, Secretary of the Citizens' Electric Light, Heat & Power Company, states that it is proposed to construct an electric light and power plant.

NEW BRUNSWICK, N. J.—A committee of citizens has appointed former City Surveyor A. Atkinson to look into the matter of constructing an electric light plant. No action has yet been taken by the city officials.

JERSEY CITY, N. J.—The Quito Electric Light Company, of Jersey City, has been incorporated by W. B. F. Rogers, F. A. Gaynor and John T. Smith. The capital stock is $400,000.

PASSAIC, N. J.—At the last meeting of the City Council the Public Service Corporation made an offer to supply arc lights at $85 per light per year and charge 12 cents per kw-hour for commercial lights. This proposition will hold good, provided the contract which the city made with the Weehawken Lighting Company is rescinded. The latter was to have built a plant in Passaic, but did not do so.

LITTLE FALLS, N. Y.—The Council has granted the Hudson River Electric Power Company, a 50-year franchise to build and operate its lines in Little Falls.

PALMYRA, N. Y.—The Niagara & Lockport Power Company is stated to have petitioned Council for a franchise to furnish electricity for heat, light and power.

WHITNEY, N. C.—The work of constructing the dam, canal and power house of the Whitney Company, at Whitney, N. C., is said to be about 25 per cent done and will be completed, according to the company's officials, in 1907.

HOPE, N. D.—The question of constructing an electric light plant and water works is under consideration here.

CLEVELAND, OHIO.—The Bradley Light, Heat & Power Company has been incorporated in this city with a capital stock of $1,000. The incorporators are: M. A. Bradley, George Lillis, J. L. Burgess and others.

KENT, OHIO.—An electric lighting system is to be installed in the round house and yards of the Erie Railroad Company at Kent, Ohio.

EL RENO, OKLA.—The electric light company in this city has sold all of its rights and title to the gas company for $68,500 in cash.

WOODWARD, OKLA.—The Woodward Cotton Company proposes to construct an electric light plant at a cost of $6,000.

HOMESTEAD, PA.—The Homestead Light, Heat & Power Company has been incorporated, with a capital of $5,000, by J. Clyde Miller and J. Jos. Gibson, of Homestead, and others.

PHILADELPHIA, PA.—S. L. Brumbaugh, general manager of the Juniata Hydro-Electric Company, states that the total cost of construction of the proposed electric plant on Juniata River will be about $1,000,000. Bids for electrical equipment will be received about Jan. 1. Wm. H. Cushman is the engineer.

NEWPORT, R. I.—The Old Colony Street Railway Company has entered into a contract to light the city of Newport with arc lights for 28½ cents per light per night, from dusk to drawn and 25 cents for lamps to burn from dusk till midnight and 9 cents for incandescent lights. The city of Newport was paying 45 cents per light per night. The new schedule of rates will effect an economy of $7,000 a year.

ABERDEEN, S. D.—The citizens have voted to issue $35,000 bonds for the construction of a municipal lighting plant.

DAYTON, TENN.—C. F. Dowker, of Grandview, has purchased of Thomas E. Stone the city electric light plant and assumed charge. It is understood that the consideration was $5,000.

EAGLE PASS, TEX.—The Texas-Mexican Electric Light & Power Company has increased its capital stock from $40,000 to $80,000.

SALT LAKE, UTAH.—The Blue Bench Co-operative Water Company, which is constructing irrigation works in the Blue Bench district, has filed an application for 200 second-feet of water from the East Fork of Rock Creek. The company proposes constructing an 850-hp plant to be operated under a head of 40 ft. for lighting and power purposes. The water will be diverted from Rock Creek through a canal six miles long.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Malad Light & Power Company, Malad, Idaho, have been filed. The new company has acquired the franchise and holdings of C. C. McLaughlin and Frank Moore, at Malad. The capitalization of the company is $100,000, and D. H. Taggart, J. A. Largent, G. C. McLaughlin, of Salt Lake, and G. H. Jay, of Great Falls, Mont., are named as the officers.

LARAMIE, WYO.—Articles of incorporation of the Laramie Light & Power Company, with a capital stock of $75,000, have been filed. The incorporators are H. E. Kelley, W. C. Sterne, Carleton Bliss and H. E. Nutting.

PHOENIX, B. C.—The Providence Mining Company will install a complete electric plant here at a cost of $30,000. P. J. Dermody, superintendent.

PHOENIX, B. C.—It is said that the Kootenay Light & Power Company will expend $1,000,000 on a new line into the Boundary districts. Poles are now being got out for the wire which will carry 60,000 volts.

MOOSEJAW, CAN.—The Council is having a by-law prepared to raise $30,000 for installing an electric light plant. Address the town clerk.

OWEN SOUND, ONT.—The Council is having a by-law prepared to raise $150,000 by the sale of debentures to install an electric lighting plant.

CAMPBELLFORD, ONT.—The Board of Trade has recommended to council that an electric lighting plant be installed.

NORTH TORONTO, ONT.—The Council has decided to call for tenders of the construction and installation of an electric lighting plant. Address the city electrician.

KINGSTON, ONT.—The light committee of the City Council of Kingston had the city engineer figure out the cost of lighting the city's streets by electricity, and he made it at $59.50 per lamp per annum. The committee then recommended that the price be reduced to $62 each per year and to increase the number of street lights. The price is about the lowest in the smaller cities of Ontario.

FORT WILLIAM, ONT.—The plant of Kakabeka Falls, near Fort William. Ont., will have a present capacity of 28,000 horse-power, and this can be provided without having, in the eye of the casual observer, any appreciable effect on the falls. It is intended that, from the power house at the point of generation, the electrical power will be transmitted to Fort William at a pressure of 25,000 volts to the sub-station now being erected at the west end of the town. From the river above Ecarte Rapids an aqueduct is being laid, and at an elevation that will add 40 feet to the height of the falls, which is 120 feet. An additional 20 feet will be obtained from the lower rapids where the turbines are being placed, making a total head of 180 feet.

MONTEREY, MEX.—Gustave A. Lilliendahl has obtained a concession from the federal government to install a large electric power plant in the municipality of Santiago, State of Nuevo Leon. The water of the San Juan River will be used to generate the electric power.

PARRAL, MEX.—A syndicate of Pennsylvania and Mexico capitalists are preparing to install a large hydro-electric plant on the Rio Verde River, in the State of Durango, for the purpose of generating electric power for supplying the city of Parral and the mines of the Parral district. The promoters of the enterprise have obtained concessions from the federal and state governments.

QUERETARO, MEX.—The new power house of the Hydro-Electric Company, at Queretaro, is completed and the machinery is being installed. It is expected that the plant will be ready to start about the first of the coming year. President Porfirio Diaz will probably be present at the opening ceremony. The old electric light plant of San Antonio, which has been supplying the city with lights, is worn out and has been shut down. The city will be in darkness until the new plant is started.

GUADALAJARA, MEX.—The installation of a hydro-electric plant at the junction of the Bolanos and Santiago rivers is being considered by Carlos Romero, a wealthy mining man. He has employed Engineer Felix Araiza to make the preliminary surveys for the proposed plant. He has made application to the federal government for a concession. It is Mr. Romero's intention to install a plant which will develop about 3,000 horse-power. The power will be used by the mines and towns of that district for lighting and power purposes.

CITY OF MEXICO, MEX.—A number of water-power concessions have recently been applied for or approved by the Mexican Government. The Yaqui Copper Company has applied for a concession to utilize 340,000 litres of water per minute from the Yaqui River for motive power. N. Dominguez and L. Sotomayor have applied for a concession to make use of the waters of the River San Pedro, in the district of Camargo, Chihuahua. L. G. Daza and J. Pita plan to establish a power plant in the district of Zacatlan, Puebla, and ask for a concession to use the waters of the River Tomotlan, a tributary of the Tecolutla River.

HALIFAX, N. S.—A municipal plant may be decided upon for Halifax, but at present the city is simply obtaining information in reference to the experience of other cities with municipally owned plants. F. W. W. Doane is city engineer.

The Electric Railway.

DENVER, COL.—The Denver & Southeastern Railway Company has been incorporated with a capital stock of $1,000,000. Those interested are W. H. Tunis, H. Ogle Tunis, T. B. Doane, W. E. Temple, L. W. Herring and W. C. K. Berlin, all of Denver, and I. C. Cockey, of Washington, D. C.; F. A. Sherwood, of Philadelphia, and R. D. Whiting, of New York

CENTRALIA, ILL.—Chicago promoters have made a proposition to build an electric railway between this city and Salem by way of Odin and Sandoval, provided the citizens along the line subscribe for $80,000 preferred stock. The proposed road would cost about $400,000. The Business Men's Association has the matter under consideration.

MATTHEWS, IND.—The Matthews, Marion & Muncie Railroad Company has been incorporated. This new line will be operated by electric power.

INDIANAPOLIS, IND.—The Columbus, Greensburg & Richmond Traction Company has revived the project to build an electric railway from Columbus to Greensburg and Richmond.

LAFAYETTE, IND.—W. S. Reed, of the Chicago & Southern Traction Company, announces that the Lafayette-Kankakee link will be constructed at once, without waiting for the completion of the line from Chicago to Kankakee.

WABASH, IND.—It is rumored that the Big Four Railroad has bought the completed grade of the Indiana Central Traction Company's line between this city to North Manchester, with a view of killing off the extension of the Indiana Northern, which now operates between Wabash and Marion and is now proposing to extend its line to North Manchester, paralleling the Big Four.

TISHOMINGO, I. T.—The Tishomingo Construction Company has been incorporated with a capital stock of $25,000. W. M. Lucas is president and A. H. Chapman, vice-president. It is empowered to build electric roads.

BOSTON, MASS.—The Railroad Commissioners have approved the issuance of $200,000 bonds by the Western Massachusetts Street Railway Company. Thee company applied for the right to issue to the extent of $300,000.

KALAMAZOO, MICH.—At the annual meeting of the Michigan Traction Company and the Michigan Traction Extension Company held in this city, directors were elected as follows: Michigan Traction Company: Evans R. Dick, Frederick J. Lisman, Gerald Holsman, J. Horace Harding and H. C. Winchester, of New York City; George S. Graham, of Philadelphia, and J. W. Osborn, of Kalamazoo. Michigan Traction Extension Company: Evans R.

Dick, F. J. Lisman, Gerald Holsman, of New York City; George S. Graham, of Philadelphia, and Alfred Mills, of Kalamazoo. The election of officers of both companies will take place in New York.

BOSWELL, N. M.—J. W. Hall, of Memphis, representing the eastern capitalists, is here with a view to securing a franchise for the building of an electric railway in this city.

OSSINING, N. Y.—Application has been made to build a new trolley line from Ossining to the Croton Dam, thence to Croton, Oscawana, Brugers, Montrose and Verplanck's Point, to open up a vast tract of land for residence and small farming purposes and to supply a demand expected to follow electrification of the New York Central lines. Maps have been made and surveys completed.

OKLAHOMA CITY, OKLA.—The City Council has granted a franchise to the Oklahoma Interurban Traction Company to construct an electric railway in the southern portion of the city.

ALLENTOWN, PA.—A controlling interest in the Allentown & Reading Traction Company has been purchased by the Pennsylvania Railroad Company. The Pennsylvania, it is understood, will come to Allentown by this route, the Berks County terminal of which is a few miles from Reading and the Pennsylvania's Schuylkill Valley branch.

ARDMORE, PA.—A special meeting of stockholders is to be held this week of the Ardmore & Llanerch Street Railway Company to consider the matter of increasing the capital stock from $200,000 to $300,000, and proxies for a majority of the stock in favor of the plan are held by the officers of the company. The stock will be offered to shareholders at par, every four shares entitling the holder to subscribe for one share of the new stock. Fifty thousand dollars of the new stock will be issued immediately.

GREENVILLE, PA.—The Shenango Traction Company, which proposes to build an electric railway from New Castle to Meadville, via Sharon, Sharpsville and Greenville, will on Dec. 5 make application for charters for the following lines: New Castle Northern and New Castle Central, covering the city of New Castle; Northern Middlesex, covering West Middlesex and south to New Castle, north to Wheatland; Shenango Southern, covering Wheatland; Shenango, Midland, covering Sharon and South Sharon; Shenango Northern, covering Sharpsville and vicinity. The incorporators are James D. White, E. A. Henry and C. G. Glatzau, of Pittsburg; Edwin C. Ripley, of Sherman, N. Y., and W. H. Waugh, of Greenville. Private right of way has been secured from New Castle to Sharpsville.

KNOXVILLE, TENN.—The Knoxville & Maryville Railway Company, with a capital stock of $100,000, is to be incorporated to build an electric railway from Knoxville to Maryville. Those interested are Joseph Burger, president of the Maryville bank, of Maryville; and J. P. Gaut, Robert Vestal, Howard Cornick, J. Cal Sterchi, Dr. W. S. Nash and others, of Knoxville.

LULING, TEX.—Mr. Oscar H. Stair informs us that the San Marcos-Luling Interurban Railway Company will build a trolley line between the two points a distance of 25 miles. They have bought ten acres of land at Tentress, 9 miles from Luling, on the San Marcos river. Mr. A. T. Fisher, of Boston, Mass., promotor of the railway, and R. E. L. Shaw, a bridge engineer for a Dallas firm of contractors, have been over the ground recently.

BELLINGHAM, WASH.—The Nooksack Valley Rapid Transit Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000, and the incorporators are Ed. Brown, of Custer; James Morrison and J. Wm. Welch, of Ferndale; A. J. Welch and J. W. Rose, of Bellingham, and W. L. Hart, of Custer.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railroad Company is preparing to supply farmers in the Burnaby district with power for the running of farm machinery.

NEW WESTMINSTER, B. C.—W. H. Moore, of this city, is having plans prepared for an electric railway to run from Spence's Bridge to Thompson River, a distance of 100 miles.

ST. JOHNS, N. B.—The Carleton Electric Light Company's property, which was recently purchased by John Russell, Jr., has been transferred to the St. John Railway Company, Mr. Russell having sold to that company.

New Industrial Companies.

THE UNIVERSAL LIGHT & EQUIPMENT COMPANY, of New York, has been incorporated, to deal in lighting appliances and fixtures. The capital stock is $1,000,000, and the directors are: James McIntosh, L. J. Lerolle and E. M. Fireman, New York.

THE TREMAIN ELECTRIC COMPANY has been formed at Brockton, Mass. Capital, $4,000; par $10. President, Arthur H. Anderson, Brockton; treasurer, John A. Brackett, Lawrence; clerk, Herbert N. Dean, Brockton. Directors as above and Amanda M. Brackett of Lawrence.

THE ARKNOT COMPANY, of Hartford, Conn., has filed a certificate of incorporation. The company will make and deal in devices for the generation, storage, control, transmission and utilization of electricity, etc. Joseph Sachs, L. P. Waldo Marvin and Charles E. Parker are the incorporators. The authorized capital is $75,000.

THE UNITED STATES ELECTRIC TOOL COMPANY has been incorporated at Columbus, O., with a capital stock of $25,000, by William A. McAllam, D. J. Hauss, J. A. Smith, C. F. Kleinschmidt and G. H. Felter. The company was a $3,000 Kentucky incorporation. It has been established for nearly a year, and is engaged in the manufacture of electric tools.

Legal.

NEW YORK LIGHTING COMMISSION.—Justice Henry T. Kellogg, of the Supreme Court, has handed down a decision restraining the village of Potsdam, N. Y., from building a municipal electric lighting plant, permission not having been obtained from the State Gas and Electric Commission, although the resolution to build the plant was adopted by the voters nearly three months before the law creating the gas commission went into effect. He holds that the matter is subject to the ruling of the new board.

Obituary.

MR. CHAS. CUTTRISS.—During a fit of temporary dementia, occasioned by his poor physical condition, Mr. Charles Cuttriss, inventor of the Cuttriss syphon recorder and head of the electrical department of the Commercial Cable Company, shot himself in his home in New York City on Nov. 18. He leaves a widow and three children. Mr. Cuttriss had been in the employ of the Commercial Cable Company for twenty-one years, during which his work had taken him almost everywhere that the company's wires lead. His suicide was indirectly due to malaria, which he contracted while in the Philippines in 1903, when he had an important part in the work of laying the Pacific cable by his company. Those of his friends who had met him recently were greatly concerned as to his evident failure in health and strength. Mr. Cuttriss was a native of Bedford, England, where he was born 56 years ago. He graduated from Glasgow University, where he was a student and protege of Lord Kelvin, whose submarine cable apparatus he made a special study of for years. In addition to his own improvements on the syphon recorder, Mr. Cuttriss devised and invented several electrical instruments in submarine telegraphy, fire alarms, etc., and was always improving the mechanism in his charge. His body was buried at Duxbury, Mass., near the cables to which he devoted his whole life. Mr. Cuttriss was a member of the American Institute of Electrical Engineers and the British Institute of Electrical Engineers, and the New York Electrical Society.

Personal.

ALEX. HENDERSON.

MR. ALEX. HENDERSON, who has just been added to the staff of the American Circular Loom Company, has the advantage of a close practical knowledge of the art. He is a Scotchman by birth, having been born at Edinburgh in 1859. Before he was 21 he had traveled extensively, visiting Germany, Spain, Italy, Russia, Turkey, Egypt, the West Indies, Africa, the United States, Canada, India, China and Australia. In Turkey, in 1878, he witnessed some of the most stirring events of the war of that year. Before the end of 1881 he had been twice around the world, and tiring of travel, settled down in New York in the employ of the old Weston Electric Light Company, in the Centre Street station. He next became connected with the Brush Electric Illuminating Co., and assisted in the construction of the masts on Madison Square, since removed. He was also actively connected with much of the early electric lighting line construction throughout the city. In 1883 he went West in the parent Brush Company's interests, and represented them as superintendent of construction in several parts of the United States, Canada and Mexico for about eight years. Returning to New York in the fall of 1890, he was appointed chief inspector for the Manhattan Electric Light Company, but again resumed construction work, etc., outside the city. In November, 1895, he was appointed the first chief inspector of the Bureau of Fire Alarm Telegraphs and Electrical Appliances of the Fire Department of New York. The position grew rapidly in importance, and Mr. Henderson became well known as an indefatigable official, anxious to secure the highest efficiency, and in spite of the difficulties of the work he was very popular throughout the field of supervision. In 1898, Mr. Henderson abandoned what he called the "political arena," and joined the forces of the Sprague Electric Company, with special charge of the introduction of their now standard heavily armored conduit. His successful work is familiar to our readers. More recently Mr. Henderson has been active as master of transportation for the conventions of the electrical contractors, and his efforts have been handsomely recognized by testimonial and otherwise. It is understood that his new duties will give him a roving commission all over the country.

CAPT. W. M. TALBOTT, the vice-president of the Havana Subway Company, reports the work is progressing in a satisfactory manner. The contractor, George M. Painter, of Chicago, is evidently hustling things as the following extract from the Havana *Telegraph* indicates: The work of building the subway of Havana has begun and more than a hundred men are now at work laying the pipes for the cables. Aguila Street is the scene of great activity, and the workmen who are engaged in laying the pipes are giving the people of Cuba an object lesson in construction work. Three blocks have already been laid with pipes, and the work is progressing at the rate of a block each day."

MR. H. B. SALE, general manager of the Indianapolis Telephone Company, has resigned that position. He contemplates spending a vacation in Bermuda.

MR. I. E. STOREY, the electric motor designer and inventor, has removed to Madison, Wis., in order to carry out more directly his work with the Northern Electrical Manufacturing Company.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company, has just returned from a brief trip to Europe, made for the purpose of securing much needed rest and recreation.

MR. GEORGE S. CARSON, of Iowa City, is now acting as secretary of the Iowa Electrical Association in place of P. E. Bellemy, of Knoxville, who has resigned. Mr. Carson is now engaged in getting out the printed proceedings of the last convention.

MR. D. G. EDWARDS, formerly of Cincinnati, has been appointed vice-president in charge of traffic of all the traction lines of Indiana and Ohio controlled by the Philadelphia interests, allied with the Randall-Morgan syndicate.

MR. JOHN C. WAIT, C. E., is to deliver the annual address at the tenth commemoration of Founder's Day, at the Thomas C. Clarkson Memorial School of Technology, Potsdam, N. Y. Mr. Wait is well known in the electrical field, and is the author of several books on engineering, jurisprudence, etc.

MR. CHARLES W. DODGE, who for the past ten years has been interested in engineering in New England, has entered the employ of Dodge & Day, of Philadelphia, and is at present giving his entire attention to extensive alterations and additions to the plant of the Link Belt Machinery Co., Chicago, Ill.

MR. E. V. ENSIGN.—After eleven years continuous service as superintendent of the Leominster (Mass.) Electric Light & Power Company, E. V. Ensign has handed in his resignation to take effect in the near future. Mr. A. N. Clarke, of Boston, a practical business man, well qualified to take charge of the plant, will be his successor.

MR. V. C. GILPIN has opened offices at 120 Liberty Street, where he will represent the Tower-Burford knife switches and panel boards, the Monarch special lamps and "Arc Burst," and the Acme refilled incandescent lamps. Mr. Gilpin is widely known in the electrical supply trade not only of New York, but throughout the country.

MR. GEORGE MOORES, secretary of the British Weight and Measures Association, has arrived in this country for a visit of a month. During his visit Mr. Moores will see a number of gentlemen particularly interested on the subject of weights and measures, and present to them the object of his association, which is the adoption of the inch as a base in a system otherwise greatly resembling the metric system.

BLUNDELL-BARATT.—On Tuesday, Nov. 14, 1905, Mrs. Maud Barratt was married to Mr. Alfred F. Blundell, the president of the Red Telefonica, Havana, Cuba. The ceremony was performed in Christ Church, East Orange, N. J. Only intimate friends were present. Mr. and Mrs. Blundell sailed for Havana on November 18. Mr. Blundell has been in Cuba for six years, and has many friends who will welcome the couple on their arrival.

Trade Publications.

GAS ENGINES.—The Jacobson Machine Manufacturing Company, Warren, Pa., has issued bulletin A, describing engines for operation with gasoline, natural gas, manufactured gas and producer gas.

CABLEWAYS.—The John A. Roebling's Sons Company, Trenton, N. J., has issued a well-illustrated 110-page publication dealing with cableways, tramways, suspension bridges, inclined planes and cable railways.

PNEUMATIC ROCK DRILLS.—Catalogue No. 18 of the Chicago Pneumatic Tool Company, Fisher Building, Chicago, describes a complete line of rock drills for mining, tunneling and quarrying work generally. This company has recently acquired the selling rights to the McKiernan rock drills.

RAILWAY LINE MATERIAL.—Publication No. 1049 of the General Electric Company, Schenectady, N. Y., is a well illustrated 84-page catalogue dealing with railway line material and rail bonds. An interesting feature of the catalogue resides in the description of the new form of catenary construction for high-tension alternating-current railway work.

REVOLVING-FIELD ALTERNATORS.—Bulletin No. 360 of the National Electric Company, Milwaukee, Wis., describes in detail alternating-current generators of the revolving-field type for direct connection to hydraulic turbines. The generators are of either the single-phase or polyphase type, in capacities ranging from 165 to 750 kilowatts.

WESTINGHOUSE STANDARD STEAM ENGINE.—Catalogue 7004 of the Westinghouse Machine Company, East Pittsburg, Pa., is a well prepared treatise on the vertical enclosed type of simple, non-condensing engine as exemplified in the Westinghouse standard engine. The constructional details of the engine are treated at great length.

PREPARATIONS APPLIED TO BELTS.—The Cling-Surface Company, Buffalo, N. Y., has issued an instructive booklet treating of the effect of preparations applied to belts, which was written by Thomas Farmer, Jr., and C. Willard Evans. Numerous curves obtained from tests are given to show the advantageous results following the application of "Cling-surface" to leather belts.

SMALL DIRECT-CURRENT MOTORS AND GENERATORS.—Bulletin No. 21 of the Sterling Electric Motor Company, Dayton, O., describes a complete line of small and medium size motors and generators of the direct-current type. These machines are of sturdy construction. The frame is made of soft cast iron, and the magnet-cores are of solid steel, cast welded into the frame, and provided with laminated pole shoes securely bolted to the magnet-core. These machines are built in sizes from 1/12 hp to 10 hp.

THE AMERICAN ARC LAMP COMPANY, of Kalamazoo, Mich., has issued an attractive little folder speaking of the use of enclosed arcs in factories, foundries and machine shops. The cover shows three shops and several detached buildings that are flooded with light, as indicating the value of the American arc lamp, while the inside pages of the circular show the lamp both closed and open, the latter illustration showing the ease with which all parts of the lamp may be inspected.

HYDRAULIC ENGINEERING.—The Roberts & Abbott Company, Schofield Building, Cleveland, Ohio, has issued an illustrated folder calling attention to its hydraulic engineering department. Views are given of your general types of dam construction, namely, masonry dam, steel-concrete dam, steel gravity dam and timber gravity dam. It is stated that some one of these, with minor variations, adapting it to the local conditions, will usually be found best for any locality.

C. H. M'GIEHAN & CO., 11 Broadway, New York City, are manufacturers of machinery which makes and assembles parts automatically. Some of the work that the company has done is little short of marvellous in the fineness of the machinery, its delicacy and the precision with which it operates. Just as an advertisement they have distributed a thermometer with a Fahrenheit scale which, in addition to an announcement of their own contains the decimal equivalents of fractional parts of an inch from 1/64 to one. It will prove a useful adjunct in an engineer's office.

TELEPHONES.—The S. H. Couch Company, 156 Pearl St., Boston, Mass., has issued bulletin No. 12, dealing with telephone switchboards and parts. Illustrations are given of some standard apparatus and a few suggestions are made for the prospective customer. Booklet No. 9 of the same company treats in detail of switchless intercommunicating telephones. A view is given of a fifty-station automatic reset telephone which was furnished to the Northampton (Mass.) Insane Hospital. A single storage cell supplies all of the current needed for the talking circuits of the entire system. The company has also issued a folder illustrating and describing automatic intercommunicating telephones of the wall and portable desk types.

MECHANICAL DRAFT.—The B. F. Sturtevant Company, Boston, Mass., has just issued bulletin No. 75, entitled "Mechanical Draft. What It Is What It Does." This booklet not only briefly presents the salient features of this system of draft production, but illustrates a variety of plants which clearly show "what it is." The suggested query in the words, "what it does," is answered thus: It does what an ordinary chimney is incapable of doing. Its cost is from 20 to 40 per cent. of that of a chimney; its intensity permits of the burning of finely divided or low-grade fuel; it makes possible the utilization of the heat of the flue gases which a chimney wastes in producing draft; it is independent of the weather; is automatically regulated to maintain constant steam pressure, decreases smoke, increases the capacity of an existing plant and serves as an auxiliary to a chimney already overburdened; saves space and is portable.

News of the Trade.

FREIGHT ELEVATORS.—A very large order for freight elevators was recently closed through the Pittsburg office of the Otis Elevator Company for a single installation of 44 freight elevators in the new building of the Pittsburg Terminal Warehouse Company, of Pittsburg, Pa. These elevators have a lifting capacity of 6,000 lbs., and a car travel of about 100 ft.

TELEPHONE RECEIVER.—A new, permanently adjusted all-metal receiver, with no metal parts exposed, was recently placed on the market by the International Telephone Manufacturing Company, Chicago, which reports a brisk demand for this instrument, as well as for its improved granular carbon transmitter.

PAPER MILL INDUSTRY.—The Westinghouse Electric & Manufacturing Company has recently equipped a number of paper mill grinders with alternating-current motors. The question of driving grinders by means of electric motors has been agitated for several years, and there has always been some question as to the feasibility of the scheme. The operation of the grinders installed, however, has been so entirely satisfactory as to leave no question, so far as the practicability and efficiency of this drive are concerned.

CHICAGO ELECTRICAL EXHIBITION.—Reports from the management of the Electrical Trades Exposition Company, of Chicago, which is to hold the Electrical Show at the Coliseum in that city Jan. 15 to 27, 1906, are said to be very encouraging. Nearly one-half of the available 38,000 square feet in this building has already been taken. Most of the leading manufacturers have been assigned space. Homer E. Niesz, of the Chicago Edison Company, chairman of the committee on publicity, is getting in some good work in that department.

THE SHOW AT THE GARDEN.—The list of exhibitors at the Madison Square Garden Electrical Show, to be held Dec. 12 to 23, has already reached proportions gratifying to the management. The following firms have already definitely selected their spaces and signed contracts for them: National Carbon Co., Joseph Goldfinger, Eastern Carbon Works, American Telephone Journal, Thos. M. St. John, Guy M. Gest, Magneta Clock Co., Peerless Electric Co., Magnet Wire Co., Waterbury Co., Electro-Dynamic Co., Gray National Telautograph Co., General Storage Battery Co., Natural Food Co., Stow Mfg. Co., Chicago Pneumatic Tool Co., Vandyck-Churchill Co., Gold Car Heating & Lighting Co., New York Telephone Co., William Krug, Standard Vitrified Conduit Co., Niagara Tachometer & Instrument Co., National Battery Co., Clark Electric & Mfg. Co., National Meter Co., Electric Journal, Engineering News, Douglass Mfg. Co., International Correspondence Schools, Brunswick Refrigerating Co., Electro-Radiation Co., Simplex Electric Heating Co., American De Forest Wireless Telegraph Co., Mohican Springs, Wireless Railway Co., Burke Electric Co., George L. Mason Co., Electrical Age, Waite & Bartlett, Ovington Mfg. Co., Kinsman Block Signal System, Kinsman Electric Ry. Supply Co., Veedee Vibrator Co., Wireless Railway.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 14, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

804,204. COUPLING FOR CONDUITS; William S. Brown, New York, N. Y. App. filed Apr. 15, 1905. The usual connection box has an internally coarsely threaded stud projecting therefrom, which is divided longitudinally into two halves, one of which is removable. The cable end has correspondingly coarse threads formed thereon which are engaged with the fixed half of the stud; after which the removable half is clamped in position.

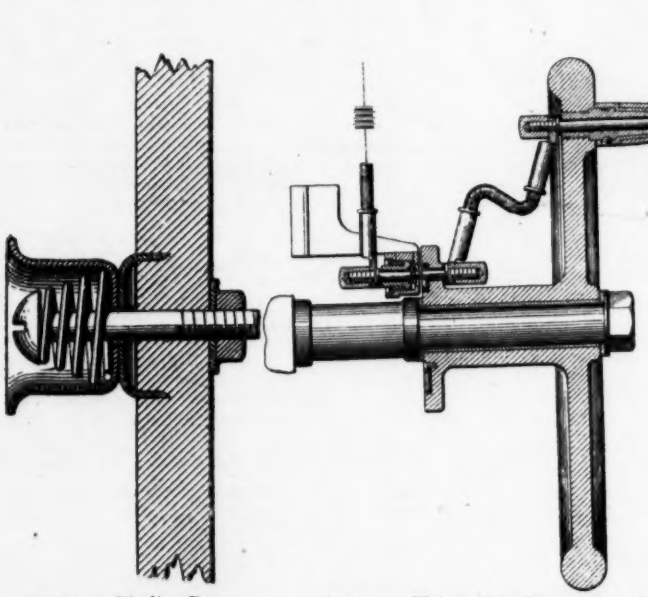
804,211. DENTAL SWITCHBOARD; Monroe N. Callender, San Francisco, Cal. App. filed Jan. 30, 1905. A small movable panel board has the various switches upon its face, and has a multiple wire flexible connection extending to the fixed wall plug or plugs.

804,231. RAILWAY SIGNAL; Joseph Irwin, St. Louis, Mo. App. filed Jan. 21, 1905. A transparent disc has radiating sectors of differently colored glass and a rotatable disc with alternating opaque sectors is supported adjacent thereto, so as to turn through a certain part of a revolution and cover up the glass sectors of one or the other color.

804,232. BINDING POST; Frank Jackson, Denver, Col. App. filed Dec. 14, 1904. A spring binding post, the two parts of which are formed of sheet metal cups in yielding spring pressed contact with one another at their bases.

804,250. APPARATUS FOR THE MANUFACTURE OF INDUCTION COILS; Leslie B. Miller, London, England. App. filed Mar. 9, 1904. For the purpose of manufacturing the "wafer" windings for induction coils, the patentee clamps a sheet of gummed paper upon the flat face of a spinning disc and leads the wire gradually outward toward the circumference so that it is wound in a spiral layer.

804,256. SIGNAL FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed July 11, 1902.



804,232.—Binding Post.

804,331.—Firing Attachment for Guns.

804,279. TRANSMITTER; Anthony Van Wagenen, Sioux City, Ia. App. filed April 30, 1896.

804,280. TRANSMITTER; Anthony Van Wagenen, Sioux City, Ia. App. filed May 4, 1896.

804,291. ELECTRICAL APPARATUS FOR PRODUCING OZONE; Albert C. Wood, Philadelphia, Pa. App. filed Feb. 17, 1905. A series of blades with their outer edges serrated radiate from a central insulating core into proximity to longitudinal contact strips annularly spaced around the interior of the casing. The ozonizing discharge takes place between the serrations and the strips.

804,297. SAFETY CROSSING SYSTEM FOR RAILWAYS; Walter J. Bell, Los Angeles, Cal. App. filed May 15, 1905. All the trolley wires have tappets adjacent the crossing so that cars passing onto the crossing from one track strike the tappets and automatically disconnect the power from the crossing portion of the other line.

804,298. AUTOMATIC SAFETY CROSSING SYSTEM FOR RAILWAYS; Walter J. Bell, Los Angeles, Cal. App. filed June 1, 1905. Relates to improvements in the above for the purpose of avoiding collisions between the cars standing on a single block when the current is suddenly turned thereon by the automatic devices above mentioned.

804,331. FIRING ATTACHMENT FOR GUNS; John F. Meigs and Heman C. Jakobsson, South Bethlehem, Pa. App. filed Aug. 19, 1903. The usual hand wheel for manipulating the gun carriage has a button upon its operating crank by which the gun may be electrically fired at the precise instant the adjustment is satisfactory.

804,344. ELECTRICAL SWITCHING APPARATUS; Walter J. Richards, Milwaukee, Wis. App. filed Nov. 4, 1904. A row of dash pot controlled contactors are effective to gradually cut out resistances in the secondary circuit of an induction motor as the latter comes up to normal speed.

804,355. DYNAMO ELECTRIC MACHINERY; William L. Waters, Milwaukee, Wis. App. filed Dec. 5, 1904. A field magnet having a large number of annularly spaced internally projecting pole pieces over which the coils are wound. The coils are held in place by short wedges engaging suitable grooves upon end plates which are provided for this purpose.

804,365. DEVICE FOR PREVENTING CONTACT IN TELEGRAPH LINE-WIRES; William L. G. Appleby, Germantown, Md. App. filed Oct. 7, 1904.

804,370 SUPPORT FOR THE SHAFTS OF INSTRUMENTS; Frank R. Beckert, Lynn, Mass. App. filed Apr. 5, 1904. Has means for simultaneously moving the bearings out of supporting relation to the movable number and at the same time clamping said member to hold it.

804,371. ELECTROMAGNETIC WHEEL; Hugh Behan, Seattle, Wash. App. filed Jan. 6, 1905. A series of magnets are radially disposed within the driving wheel of an engine so as to be successively energized at the instant when they are in proximity to the track.

804,381. SNAP SWITCH CONTACT MECHANISM; Charles A. Clark, Hartford and Ellsworth A. La Har, New Britain, Conn. App. filed Mar. 25, 1904. A snap switch, the blade of which is supported by insulating studs, and has a slight longitudinal movement so as to make a more uniform engagement with the two contacts.

804,387. LOCKING DEVICE FOR INCANDESCENT LAMP BULBS; Ralph E. Davis, Alton, Ill. App. filed Feb. 18, 1905. An internally flanged ring is formed of two half sections hinged together with interlocking clasps at their free ends. The ring is clamped upon a lamp after which the latter is locked against removal until the ring is released by suitable key.

804,389. ELECTRIC CIRCUIT CLOSER; Alexander Dow, Detroit, Mich. App. filed Jan. 22, 1904. A floor push or button comprising a pair of circular metallic discs spaced apart by a rubber washer at their centers. Pressure at substantially any point is effective to bring some portions of the peripheries of the discs together so as to make electrical contact.

804,428. PAPER CUP; Charles G. Perkins, Hartford, Conn. App. filed Oct. 18, 1904. An insulating cup formed of a paper disc with tangentially corrugated edges, which crimp together spirally so as to form a paper shell.

804,429. PROCESS FOR MAKING CONTACTS; Frank Petz, Nuremberg, Germany. App. filed Oct. 20, 1904. A process of electrically connecting a metallic element with carbon blocks by enclosing all the parts in a rigid box, embedding them in cement which presses the elements into good contact when hardened.

804,431. TELEPHONE INSTRUMENT; Egbert A. Reynolds, New York, N. Y. App. filed Aug. 19, 1904.

804,436. TOOL; Charles D. Schultz, New York, N. Y. App. filed May 26, 1905. A blade projects from a cylindrical box, forming a handle, which has resistance wire wound therein so as to warm the blade.

804,440. DYNAMO-ELECTRIC MACHINE; Charles P. Steinmetz, Schenectady, N. Y. App. filed April 22, 1904. (See Page 913.)

804,484. THERAPEUTIC APPARATUS; Carl O. Lindstrom, Chicago, Ill. App. filed Feb. 20, 1905. Employs a two-part box with hinged covers into one compartment of which a patient may be placed. The other compartment has ozonizers and incandescent lamps therein for supplying light treatment.

804,595. ELECTRICAL CONTROLLER; Nathan K. Garhart, Indianapolis, Ind. App. filed May 25, 1905. A floor switch for dentists having two foot levers, one of which runs the dental motor in one direction at varying speeds, while the other reverses the motor and also controls its speed in the reverse direction.

804,603. BRANCH BLOCK FOR ELECTRIC WIRING; Nathan B. Hoyt and James H. Martin, New Haven, Conn. App. filed Nov. 14, 1904. Has three longitudinal main grooves and two branch grooves at right angles thereto, connection being made between the two outside main grooves and one of the branch grooves.

804,628. ELECTRICAL GENERATOR; Morris Schwartz, New York, N. Y. App. filed March 7, 1905. (See page 913.)

804,636. ELECTRIC SNAP SWITCH; George B. Thomas, Bridgeport, Conn. App. filed Nov. 3, 1904. A spring drum within the switch has a cord by which it is rotated to tension the spring. After a certain movement the spring is tensioned sufficiently to move the switch blades with the required snap.

804,741. FUSE PLUG; Percy Q. Lawrence, Revere, Mass. App. filed Feb. 8, 1905. The usual cover plate of an Edison socket fuse plug is made of mica through which a plug within an interior wall may be observed. When the fuse blows the plug is dislodged, which can be noted through the transparent mica disc.

804,742. PUSH-BUTTON SWITCH MECHANISM FOR TELEPHONES; Burton Leonard Lawton, Meriden, Conn. App. filed Dec. 5, 1904.

804,745. ELECTRICALLY CONTROLLED FLUID PRESSURE RAILWAY BRAKE; John S. Lockwood, Kansas City, Mo. App. filed Feb. 5, 1904. The triple valves of all the cars are operable by electro-magnets in an operating circuit which extends throughout the train.

804,648. TROLLEY; Michael Baker, Chicago, Ill. App. filed Aug. 31, 1904. The trolley pole has a supplemental spring pressed wheel thereon with a corrugated tread so as to break the ice upon the wire in advance of the usual contact wheel.

804,759. ELECTRICAL HEATER; John A. Noble, San Francisco, Cal. App. filed May 8, 1905. A hot water bag into which a slender cylindrical box having resistance wire is insertable so as to maintain the water at any desired temperature.

804,760. ELECTRIC BURGLAR ALARM; William E. Orr, Council Bluffs, Iowa. App. filed Jan. 17, 1905. An attachment for an ordinary lock having contacts within the door jamb which ring an alarm circuit whenever the door knob latch or the usual lock is withdrawn.

804,763. PROCESS OF ELECTRICALLY WELDING RAILS; Carl Pahde, Breslau, Germany. App. filed July 1, 1905. The process of electrically welding the ends of two contiguous rails by means of an electric arc, which consists in passing an electric current therethrough after the joint between said ends has been filled in the lower portion thereof with soft metal, and at the heads of the rails with hard material, thereby melting the rail ends together.